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THE METAL INDUSTRY

WITH WHICH ARE INCORPORATED
THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER:

ELECTRO-PLATERS REVIEW.

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A MONTHLY JOURNAL RELATING TO THE METAL AND PLATING TRADES

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FLUXES IN THE JEWELRY FACTORY

Some Remarks on the Melting of Gold, Silver and Platinum

By C. M. Hoke, B.S., A.M.*

The fact that the precious metals do not oxidize at high temperatures has meant that comparatively little interest is taken in the fluxes that are used in melting them. None the less, the flux is important, as every melter knows, and many an expensive mistake has followed a little ignorance. Fluxes are employed to serve several purposes —to separate metal from its ore by liquifying the rocky material, to refine metal, to exclude oxygen, to introduce oxygen, to reduce oxides. In fact, the word *flux* has come to cover almost anything that may be put in a crucible with molten metal.

In the average jewelry factory the following processes are pretty apt to be carried out: removing the last bit of impurity from fine gold; preparing alloys and solders of various fineness; melting gold and silver scrap into buttons and bars; reducing silver chloride to metallic silver; collecting the metal in polishings into buttons; melting platinum in the form of scrap, filings, and black.

CHOICE OF FLUX.

The choice of flux, naturally, differs with the nature of the process. Thus, let us consider two common cases; first, the preparation of some 14-k gold from new fine gold, silver, and copper, free from impurities. Our purpose here is to keep oxygen out of the melt, because if any of the silver and copper oxidizes the quality of the gold will be raised unduly, and will probably be brittle because of included oxides. Further, if any oxides do form, we want them to be reduced back to metal again at once. Therefore we shall cover the metal with a thin layer of clean powdered charcoal. This layer excludes air, and when the mixture is stirred the charcoal tends to reduce to metal whatever oxides it comes in contact with.

For the second case, suppose we wish to purify and melt into a fine gold button some of the powder precipitated from solution. Here, instead of excluding oxygen, we wish to introduce it, that it may burn up any base metal present and raise the quality of the gold as much as possible. Therefore we drop small amounts of saltpetre into the molten metal. This gives off quantities of oxygen when heated, and base materials burn to oxides. And, since it is desirable to get these oxides out of the neighborhood of the gold promptly, we cover the surface of the metal with a thin layer of borax, in which the oxides dissolve as they form. The liberated oxygen stirs up the metal, and the borax prevents its sticking to the sides of the crucible.

CRUCIBLES

Likewise, different crucibles are used for different purposes. A graphite crucible, after the manner of all stuff containing carbon, helps to reduce oxides, and therefore is used when karat gold is being melted. But it is not used when gold is being purified by saltpetre, for two reasons: first, the graphite tends to defeat the purpose of the saltpetre by preventing the formation of oxides, and second, the saltpetre will eat the crucible. Therefore use a sand crucible with saltpetre.

It is the custom to place copper in the bottom of the crucible, then silver, then gold on top, when making karat gold. This plan serves to protect the most oxidizable metal by covering it up, while the stable gold is nearest the surface. At the same time this arrangement tends to bring about a certain amount of mixing—as the heavy gold melts it sinks, and the lighter copper rises through the mass. This is rarely sufficient mixing, however; it is necessary to stir the melt with a hot iron or graphite rod, or a wooden stick, carefully but thoroughly. The common plan of doing without any stirring, and then cutting up the metal and remelting it a time or two, is extravagant of heat and time, and usually is no more efficient.

CLASSES OF FLUXES.

Fluxes may be divided into four classes: (1) those that introduce oxygen, such as potassium nitrate and sodium nitrate, (familiarly called saltpetre, nitre, and Chili saltpetre) and are used for refining. The reducing agents (2) are those that *remove* oxygen by reducing oxides that are already there. To this belong the many carbonaceous and organic materials—charcoal, sugar, soda ash (dry sodium carbonate) argol, pearlash (dry potassium carbonate), potassium cyanide, resin, and so on. (3) Those which neither add nor take away oxygen, but which form a coating that *excludes* it; borax and boric acid are the commonest of these, and they further dissolve and flux off whatever oxides may be present. Then (4) come the chlorides, used as tougheners for slightly brittle gold; ammonium chloride, mercuric chloride, and cupric cloride are the most popular ones. There are other fluxes, but these are the common ones.

BORAX.

Borax is perhaps the most popular of fluxes. If a crucible is rubbed well inside with borax, the metal will not adhere to it. It is largely used in soldering. Its value, as has been said, is twofold—it forms an air-excluding film, and can dissolve and flux off whatever oxides are present. It does not eat into the crucible, and it does not give off fumes. Ordinary borax, the kind used in household work, is full of water of crystallization, and when it is heated this water escapes with

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much spitting and swelling. Calcined borax, or borax glass, is the ordinary borax with all the water cooked out; it costs more per pound, of course, but it obviously is cheaper to use, and much more convenient. Boric acid is used much as borax is; it is common to coat metal with a paste of boric acid when it is to be annealed. The boric acid merely keeps oxygen away from the hot surface.

AMMONIUM CHLORIDE

Another popular flux, largely used when preparing karat gold, or remelting karat gold scrap, is a mixture of equal parts charcoal and ammonium chloride. The charcoal, as always, is the reducing agent; the ammonium chloride decomposes when hot into ammonia and hydrochloric acid gas, which come off in dense white fumes; these keep air away, stir up the melt, and at the same time the chlorine unites with any small impurities to form volatile chlorides. This mixture is therefore useful when the material is suspected of containing small amounts of dirt. Ordinarily scrap metal from the benches, even when carefully picked over and freed from iron with a magnet, carries impurities, and if melted without the chloride such scrap is apt to yield a brittle bar. Accordingly the chloride is referred to as a *toughener*. Only a small amount of it should be used, and it need not be used at all when perfectly pure metals are being melted, as in the first case described.

FINE GOLD

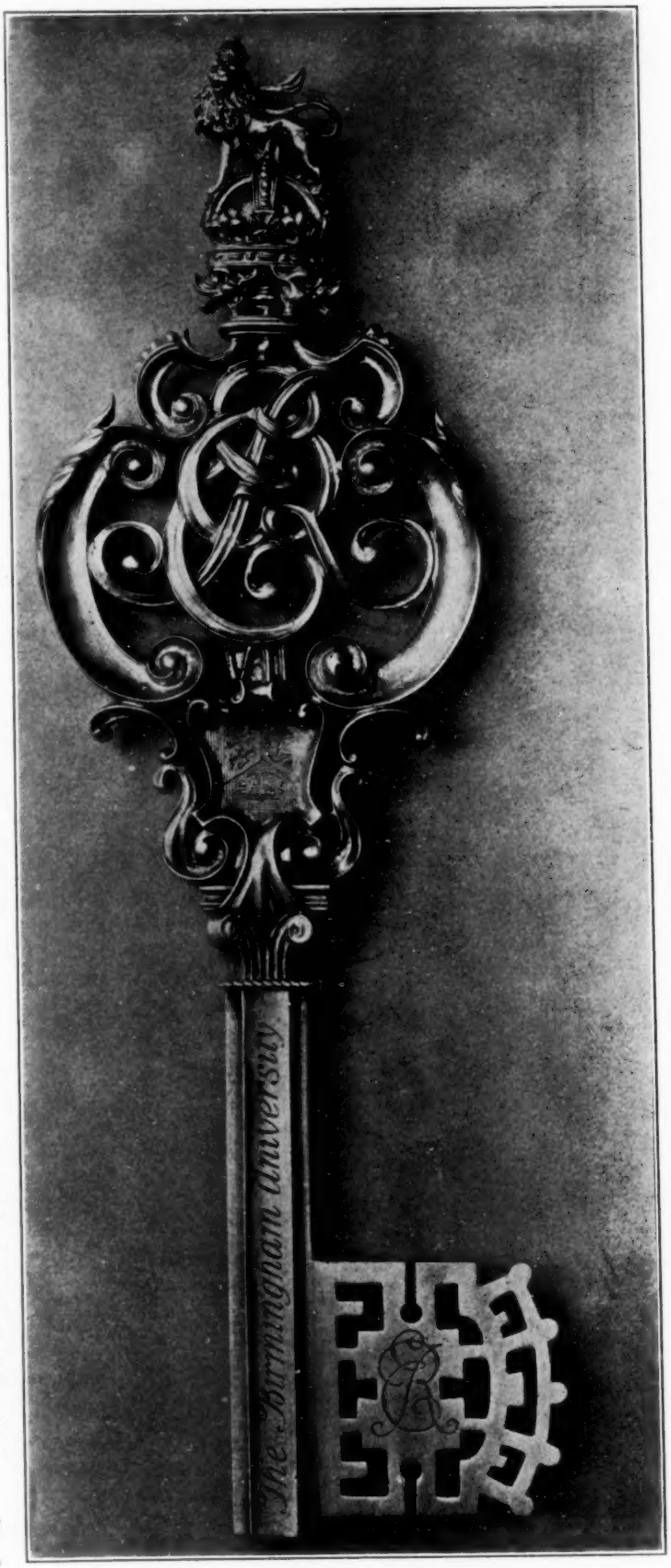
It is the custom when refining gold chemically to precipitate gold in the form of a brown powder from the aqua regia solution, using copperas (iron sulphate) as a precipitant. The aqua regia solution is apt to contain in addition to dissolved gold, a considerable amount of dissolved copper and other base metals, and occasionally a little lead. Sometimes there is a bit of silver chloride suspended in the solution. Naturally the brown powder of gold when it forms is not clean; it is wet with copper salts, is mixed with silver chloride and lead sulphate, and contains a good deal of iron from the copperas. If this powder is melted up without thorough cleaning, the button of "fine" gold will be far from pure. It is plain that the easiest way is to clean the powder before melting it. Therefore the powder is washed well with hot water and hydro-chloridic acid to remove the iron and copper salts; if silver chloride is suspected it is rinsed thoroughly and then boiled in a solution of photographer's hypo; if lead sulphate is suspected the powder is boiled in strong caustic, and a little fluorspar is placed in the crucible when it is melted.

If, after melting, the gold is still impure and shows brittleness or blisters, and must be remelted, various purifiers may be used. A second treatment with saltpetre, or the ammonium chloride or mercuric chloride mentioned, usually follows. In a recent article in THE METAL INDUSTRY* Mr. Coleman, of the United States Mint of Philadelphia, tells of refining brittle gold of about 999 fineness by means of dry cupric chloride in the proportion of ¼-ounce to 1,000 ounces of metal. Fumes are given off by all of these treatments, the fumes from mercuric chloride being particularly poisonous.

POLISHINGS

When precious metals are mixed with a good deal of dirt, as is the case when polishings are to be run down, the quantity of flux must be larger. In addition to preventing oxides, the flux must also liquify the mass so that the metals can go to the bottom in a button. Following are two mixtures in common use:

Polishings	1 pound
Soda ash	1 pound
Borax glass	½ pound
Clean sand	1/5 pound



A GOLDEN KEY MADE FROM A CASTING.

Another, to be mixed generously with polishings:

Soda ash	1 pound

*March, 1916, "Blistering of Gold Alloys."

Borax glass	4 ounces
Sand	2 ounces
Fluorspar	1 ounce

Sometimes these mixtures boil over and cause trouble. A bit of saltpetre in the first one will frequently stop that. A common thing is to add table salt to a pot that boils over—salt that has been ground up in a mortar to break the crystals and prevent their scattering when heated.

When polishings contain much platinum they are hard to run down. The molten gold and base metals serve to dissolve the platinum, so that it becomes liquid much below the melting point of the pure metal; but if the proportion of platinum is high it is necessary to add lead, or litharge, to collect the platinum particles.

OTHER FLUXES

Both soda ash and fluorspar liquify sand, and so are useful when it is desirable to get gold out of sandy material. At the same time they eat into sand crucibles. Potassium cyanide, like soda ash, is a reducing agent and fluxes sand; it melts at a low temperature and so is used when a low-melting alloy is being prepared, such as solders containing cadmium. The objections to potassium cyanide are its cost, its habit of eating the crucible, and the fact that the fumes it gives off are highly poisonous.

A mixture of three parts sodium carbonate (soda ash) to four parts potassium carbonate (pearlash) melts at a lower temperature than either salt alone, and is a useful flux when a quick fusion is wanted.

SILVER

Silver is able to absorb large quantities of air when it is hot. On cooling this air is expelled, and the metal spits, spurts and sprouts into curious shapes, and is very troublesome at times. One way to prevent this is to keep the molten metal well covered with flux so that the air cannot get in; do not pour until the metal is as cool as will flow, and pour quickly. Fluxes used are borax and charcoal, or sugar. Never use any cloride on silver.

When silver chloride is to be reduced to metallic silver it must first be thoroughly cleaned, the same as the fine gold powder above. Much hot water will wash out lead chloride; if the material has a greenish cast from the presence of copper compounds, wash it with dilute hot nitric acid, and rinse well. When dry it is mixed and melted with an equal quantity of pearlash; borax and soda ash also serve this purpose, and some of the refiners sell prepared fluxes based on soda ash, borax, and argol.

PLATINUM

Since platinum does not oxidize in the least even at its high melting point a flux is not used in melting it. Only pure metal should ever be melted; impure metal should be chemically refined first. Small amounts of impurities, such as gold, platinum solder, and silver chloride, can be burned out by repeated meltings in the oxy-gas flame, but this is poor economy—the best practice is to melt only clean metal. Very rarely does a jeweler prepare an alloy of platinum; when he does, it is the platinum-iridum alloy, and it also needs no flux.

Platinum black and platinum sponge, the finely divided platinum secured by certain processes of refining, are also melted without flux as a general thing. Some workers, it is true, sprinkle a layer of borax over them, simply for the purpose of keeping the light particles from flying away under the flame, and when a melter becomes more skillful he is apt to discard even that.

Saltpetre must not be added to any platinum-bearing material, as it will oxidize it fairly readily at high temperatures. Accordingly, saltpetre is omitted from the treatment of polishings containing platinum. Carbon is another substance that should not be permitted to come in contact with hot platinum, from a graphite crucible, from charcoal, from reducing agents, or from a reducing flame, etc., as it is apt to change the metal into brittle platinum carbide.

REFINED COPPER PRODUCTION OF THE UNITED STATES FOR THE YEARS 1913, 1914 and 1915

The United States Geological Survey has issued a final report of refined copper production.

The total production of new refined copper in 1915 was 1,634,000,000 pounds, an increase of 100,000,000 pounds from the output in 1914.

The production of electrolytic, Lake, casting, and pig copper from primary sources and the production of secondary copper, tabulated from reports of the regular refining plants in 1913, 1914 and 1915, is shown in the following table:

PRODUCTION OF PRIMARY AND SECONDARY COPPER BY THE REGULAR REFINING PLANTS IN 1913, 1914 AND 1915, IN POUNDS.

	1913.		1914.		1915.	
	Domestic.	Foreign.	Domestic.	Foreign.	Domestic.	Foreign.
Primary:						
Electrolytic	1,022,497,601	378,243,869	991,573,073	323,358,205	1,114,345,342	246,498,925
Lake	155,715,286	....	158,009,748	....	*236,757,062	....
Casting	22,606,040	....	21,506,325	....	21,555,129	....
Pig	36,004,986	....	39,334,043	....	15,047,990	....
Total primary	†1,236,823,913	†378,243,869	†1,210,423,189	†323,358,205	†1,387,705,523	†246,498,925
	1,615,067,782		1,533,781,394		1,634,204,448	
Secondary:						
Electrolytic	14,862,577		27,702,928		38,156,789	
Casting	22,360,182		4,224,052		21,417,901	
Total secondary	37,222,759		31,926,980		59,574,690	
Total output	1,652,290,541		1,565,708,374		1,693,779,138	

*Some Lake copper was refined at seaboard plants and doubtless marketed under some brand other than Lake. This has been excluded from the Lake copper.

†The distribution of refined copper of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

SOME UNSOLVED PROBLEMS OF THE ELECTRO-PLATER*

An Address Embodying Some Idea of the Troubles Besetting the Metal Finisher.

By George B. Hogaboom.

Dr. Watts, in recently addressing an assemblage of electroplaters, remarked: [1]"When information on such matters as these is available to those interested, your friends—the electro-chemists—will no longer spend months or even years in perfecting deposition from some particular electrolyte that could never be used in competition with present solutions on account of too great cost. Platers suffer no inconsiderable loss because of misdirected effort on the part of electro-chemists, who, from a lack of published information on the relative cost of the different operations necessary to plating, devote much of their time available for experiments in plating, to matters of trifling importance, or even entirely useless. I speak with some authority in this matter from sad experience." Those remarks are up to the point and emphasize that what is needed is whole-hearted co-operation and wholesome criticism for that alone will bring the electro-plater and the electro-chemist together.

The evolution of electro-plating solutions seem to have been divided into three distinct cycles—the complicated, the extremely simple, and the efficient. In the early days of the industry the construction of a solution was very complicated and little attention was given to the amount of metal deposited in a given time, or to either anode or cathode efficiency.

About five years ago, with the advent of rapid plating salts, the pendulum, like in so many other cases, swung to the other extreme, and the simple solution, one with a cyanide of the metal and an alkali cyanide, or, in the case of nickel deposition, a single nickel salt solution, was considered the only way to get a fast deposit; the speed mania had taken hold of the plating fraternity.

At the present time the pendulum is beginning to approach a more rational swing. The simple solution did not live up to its reputation, but it did one thing, and that was to set the electroplater to thinking. It was evident that the day of the complicated solution had passed—it was not efficient; the simple solution lacked some of the good qualities of the complicated one and now, at the present time, the electroplater is entering into the third cycle and his quest is for an efficient electro-plating bath. How to obtain that is the one great unsolved problem and in its solution the services of "his friends—the electro-chemists" are of inestimable value, but they must have unreserved assistance from the electro-plater. They are "useless each without the other."

In collecting data for this paper 250 letters were sent to as many foreman platers, publicity was given in two periodicals,[2] yet a discouragingly small number of answers were received. Not that there are no unsolved problems, but because the electro-plater has so far failed to realize the importance of electro-chemical research work. Some of the answers received were only problems of the individual—those of trying to duplicate some finish or overcome some local difficulty.

There is one way in which much assistance could be given the electro-plater aside from research work, and that is in giving him standardized electro-plating chemicals and general supplies.

While standardization is needed and some very valuable work is being done by the U. S. Bureau of Standards[3] on electro-typing solutions, under the direction of Dr. Blum, nothing of a definite nature can be done with electro-plating solutions until they are studied in the same manner. The construction of the solutions that are now being used commercially must be known and also the value of the metallic and chemical salts, and the effect of the several addition agents.

A member of this society who is one of the foremost men in his line of electro-plating, submitted the following problems, which illustrate those of one branch of the industry:

1. To what extent is the nature of the electro-deposit influenced by the physical structure of the metallic base, such as steel, copper, brass, Britannia, German silver, etc.?

2. What is the best cleansing process to use on buffed German silver flatware, to produce 100 per cent. perfect plating?

3. Ditto on steel and hollow-handle table cutlery?

4. What is the best method of obtaining a smooth adherent silver deposit upon perfectly cleansed German silver flatware?

(a) By placing directly in silver strike?
(b) By use of mercury dip followed by silver strike?
(c) Striking in nickel bath followed by silver strike?

5. What is the best method of obtaining smooth adherent silver deposit upon steel and hollow-handle table cutlery? Is it best to strike the silver on direct, or place in nickel bath and strike with silver afterward?

What composition of silver bath will produce the most efficient deposit, viz., most smooth and rapid, upon German silver flatware, hollow ware, deposit work, table cutlery?

What is the highest current density that can be used in this bath to obtain smooth deposits at 65 degs. F. (18 degs. C.) and what agitation is best?

7. What simple, rapid and convenient method is there for determining the amount of nickel and free acid in the nickel bath?

8. What simple method is there for determining the cause of nickel solutions working dark or otherwise unsanitary? What is the remedy?

9. How can the rusting of silver-plated table cutlery, while in use, be prevented?

10. What causes silverware to "spot out" before it reaches the consumer?

Problem 1 is about the most interesting in that it opens up a field of thought to which very little action has been paid. We know of some work that has been done along that line which has proved beyond doubt that the character of the deposit is materially affected by the structure of the metal receiving the deposit. Especially is this true of steel and German silver.

In problem 7 a question is asked which the electro-chemist on first thought would answer by saying that it would be a simple matter to titrate a nickel-plating solution for the free acid present. We know of no indicator that will give a good end point in the volumetric determination of the free sulphuric acid using a regular standard soda solution for titration. Of all the books upon electro-plating which give the method of analysis for nickel-plating solutions, Langbein alone

*A paper presented at the Twenty-ninth General Meeting of the American Electrochemical Society held in Washington, D. C., April 27-29, 1916.

[1] Monthly Review, American Electro-Platers' Society, January, 1916.

[2] The Metal Industry, December, 1915.—Monthly Review, February, 1916, American Electro-Platers' Society.

[3] Circular No. 52, U. S. Bureau of Standards.

speaks for the estimation of the free sulphuric acid.[4]

In the bath recommended by Mathers,[5] Stuart and Sturdevant both boric acid and ammonium citrate are used in a solution containing both nickel sulphate and nickel ammonium sulphate. If the bath is to be kept constant in metal and free acid how shall the plater proceed to analyze it?

Problem 10 not only applies to silver-plated articles but also to brass, copper and bronze-plated objects.[6] Much work has been done in trying to solve the "spotting out" problem but it is still with us. We have seen work baked out, boiled out, giving alternate dips in hot and cold water to remove the occluded salts, neutralizing solutions used, plating in cyanide of potassium instead of cyanide of sodium and *vice versa,* and, at times felt confident of success only to find on the following day the same attack of "measles" even under the protective coating of lacquer.

The pitting of nickel deposits is another problem to which the electro-plater has given much thought without being able to find a remedy. We disagree entirely with Mathers, Stuart and Sturdevant that pitting is caused "by the adherence of loosened insoluble particles of anode or other hard material." . . . and that "The buffing pulls these adhering particles away, leaving holes in the nickel." Such holes have never before been considered as "pitting," and the authors fail to distinguish between a rough and a pitted deposit. Pitting occurs upon smooth adherent deposits that color up easily on the buff, and there is no evidence of "holes" in the deposit. It may and very probably is caused by the adherence of gas bubbles, and, contrary to the same authors has, in a measure, been prevented by agitating the solution with air or keeping the cathode in motion. If a bath is agitated, however, the sludge will cause rough deposits and unless pure nickel anodes are used iron, with which nickel anodes are alloyed, will be deposited with the nickel. If a small enough current or voltage was used the efficiency of the bath would be greatly decreased and another exception, pitting, occurs more often in baths slightly acid than in those which are almost neutral.

Bennett,[7] Kenny and Dugliss, in their experiments with nickel solutions, found that "The best deposits are obtained when the solution is alkaline at the surface of the cathode" and "The efficiency is dependent upon the degree of alkalinity of the cathode film." It is too bad that the subject of "pitting" was not thought of in those experiments, for we believe that the cause would have been determined. It is probable that "pitting" is caused by the primary deposition of hydrogen at the cathode and, if there was an alkaline film at the cathode, that would be prevented and the nickel be deposited primarily instead. In that case there would be no gas bubbles on the cathode and consequently no "pitting."

Other problems submitted were:

11. How can nickel deposits be made to adhere firmly to tin or tinned articles?

There is no difficulty in depositing nickel upon tin so that it will stand buffing, but the deposit becomes broken it can be peeled off in strips very easily. The condition is true of imported nickel-plated tinware as well as domestic.

12. What are the factors controlling the hardness or stiffness of copper deposit? It is well known that this is dependent upon the rate of deposit, amount of free acid in the bath, temperature, impurities, etc. Why is the deposit hard or soft? The hardness is not essentially accompanied by either fine or coarse-grained deposits. The problem is to get a hard deposit independently of the rate of deposit and at will.

13. A practical solution for the deposition of chromium is greatly desired. Chromium deposits are less susceptible to the action of the air and moisture than nickel and therefore tarnish less easily.

14. A positive rust-proof coating, black in color, for iron or steel, without the use of excessive heat.

15. A dip to produce a brass coating on iron and steel by simple immersion, similar to a copper dip.

16. Why will a single nickel salt solution plate zebra-like black and white streaks when the work is given a mechanical motion during the deposition while it plates very satisfactory, white and smooth, when used as a "still" solution?

17. A substitute for platinum chloride to produce the same color effect upon silver. Platinum black is the only durable and satisfactory color for "oxidized" and "French gray" finishes at the present time.

18. Arsenious acid added to a cyanide brass solution brightens the deposit. It also materially decreases the efficiency of the bath. It is well known that the presence of arsenic in copper wire injures its conductivity. Does it affect the deposition of copper from a brass solution in the same manner?

19. If a cyanide copper solution is made from an alkali cyanide, cyanide of copper and a small amount of soda ash anode efficiency cannot be maintained at 100 per cent. unless the free cyanide content is kept at such a point that a slight decrease in the metal content will cause blistering of the deposit. What salt can be added that will corrode the anode, producing a compound that will be easily soluble in the free cyanide, and thereby keep the anode clear? Bisulphate of soda is recommended by Roseleur,[8] Langbein,[9] Barclay[10] and Hainsworth and other writers on electro-plating. That salt decomposes the free cyanide and decreases the cathode efficiency. Large amounts will result in only a slight film of copper being deposited. Watts[11] recommends bi-tartrate of potassium, which is very expensive and would increase the cost of production. Miller[12] advises aqua ammonia, the effect of which is soon lost in a hot solution.

20. A successful cyanide of zinc solution, one in which there would be a fairly good anode corrosion so that the bath could be kept uniform in metal content.

21. A plating rack or a covering for one that would not be coated with metal except at the points of contact with the articles to be electro-plated. Tons upon tons of metal are deposited upon racks every year which must be refined at a heavy expense or be sold as scrap metal.

22. A satisfactory solution for the deposition of a true bronze, *i.e.*, copper and tin. Fields[13] recommends a double ammonium oxalate solution. In experimenting with this solution Mathers found that at "first such a bath gives a rough copper, then a bright copper and then a bronze which gradually becomes whiter until it is as white as tin." He was unable to maintain conditions required for a rich uniform bronze.

23. A brass solution from which the metal can be

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[4] Electro-deposition of Metals, Langbein, 5th edition, pp. 309-310.
[5] Transactions American Electrochemical Society, 29 8 (1916).
[6] See various articles in THE METAL INDUSTRY.
[7] Bennett: Transactions American Electrochemical Society, 25, 335 (1914).

[8] Galvano-plastic Manipulations, Roscleur, Fesquest translation, 1872, p. 88.
[9] Electro-deposition of Metals, Langbein, 5th Edition, p. 321.
[10] Electro-deposition of Metals, Barclay and Hainsworth.
[11] Transactions Am. Electrochemical Society, 27, 141 (1915).
[12] Transactions Am. Electrochemical Society, 26, 63 (1914).
[13] Principles of Electro-deposition, Fields, p. 253.

deposited as efficiently as copper can be from an alkali cyanide bath and not be coarse or brittle. One in which the anode efficiency will approximate 100 per cent. without the addition of large amounts of aqua ammonia or any ammonium salts which either quickly decompose or decrease the cathode efficiency.

24. What is the comparative value of cyanide of potassium and cyanide of sodium in relation to the corrosion of the anode, solubility of the compound formed at the anode, and conductivity, in the commercial electro-plating solutions generally used?

In conclusion I wish to thank those who assisted me in trying to catalogue some of the unsolved problems of the electro-plater.

APPRENTICES

Some Remarks Pertaining to Past and Present Methods For Educating Young Men as Metal-Trade Journeymen.

By W. H. Parry.*

In the olden days and in many shops of the present era it was, and is still, the custom to bind down any aspiring boy, whose desire to be taught a trade was strong enough for him to sign an indenture on terms very favorable to his boss or bosses. In some instance the father or legal guardian of the minor was compelled to add his signature and, not infrequently, a stipulated sum of money to defray the expenses incidental to the tuition of the budding mechanic.

The so-called "tuition" was very grudgingly given, and consisted chiefly of allowing the young man to absorb a goodly dose of the shop "atmosphere." The only wonder is that the firm did not make a practice of testing, at stated periods, the degree of his absorption on a Baume scale; and then deduct the cost of the test from his already meagre wages, that is, if he was getting any.

There is an expression in use to-day known as "getting away with murder," and it applies with much potency to this apprenticeship question, because the firms who practice this crime known as "cruelty to animals" are certainly "getting away with manslaughter." There is one concern located in New York City, which specializes in teaching (?) young men how to be machinists, blacksmiths, molders, and patternmakers and they are courageous enough to attempt the impossible task of turning out a finished toolmaker, whatever that term may mean. As a bait for the victims at these works they also include tuition—in the evening—of drafting, mathematics, geometry and so forth.

In addition they throw in for good measure, an evening meal of the beanery type, so that the "stujents" don't starve to death after their arduous day's work at making money and big money at that for the firm. Does the firm share the profits with these boys? Yes, to the extent of bum meals and worse schooling and that is all. Does this firm turn out good mechanics? Yes, they do NOT. The way they treat the young men is shameful, because they are not taught anything about the trade they are supposed to learn and the defections from the ranks of these alleged apprentices are very numerous. Especially after completing the first years so-called "apprenticeship" as the boys get used to the game and refuse to stand for it any longer; even in the face of parental opposition, as it is hard for the parents and guardians to believe the stories told by the boys to the effect that they had been used as machine hands and so forth, to swell the production at the very lowest labor cost.

Even in shops that do not resort to these mean methods the apprentices rarely get a show to learn the trades properly. Again there are many shops that do give the young fellows a chance to learn, but they do not pay them according to their worth, but insist on paying them by that old and worn out method of three dollars per week for the first year, four for the next and so on until the end of the fourth year. At the end of that time they are supposed to be full fledged journeymen and in line for journeymen's wages, which they rarely get, however, from the firm where they served their time. These old fogy ideas and practices must give way to modern conditions and if we expect to keep American boys in our shops to become the mechanics of the future, they ought to be paid on the basis of their ability and worth to the concern who employ them; regardless of the fact that they are under instructions, for that is the only way to hold them.

This country is to-day infested with a lot of half-baked mechanics, who are the apprentices of yesterday and who, because of meagre pay, did not complete their term of service. They did, however, have the nerve to solicit a job elsewhere and conveniently forgot to mention the fact that they were not full fledged mechanics. Sometimes, if the work is of a simple nature they get away with it, but sooner or later the time will come when their lack of mechanical knowledge is made apparent so glaringly that they shift from one shop to another. If they are fortunate they will, by the time they reach thirty years of age, become fair mechanics.

Of course, it should not be assumed that because a boy serves his time entirely that he becomes a mechanic as there are too many instances of negative results. If the boy is making good at his trade pay him what he is worth even if you have to change his rate of pay every month. That is the way to keep the boys satisfied with their lot.

One of the best emthods in use today is to have the apprentices serve a probationary period of three months at a fair wage, for in that time it will be demonstrated whether or not they are fit for the business or not and the services of a phrenologist will not be needed if those in charge know their business. If it happens that a boy is not fit for the business tell him so in a kindly way and advise him to try some other line. I am aware of a case where a boy did not make good in the three months' period and was advised by the foreman of the department to take up aviation as a means of making a living as the boy's thoughts were "up in the air" all the time. It would have been better by far if the boy with the flighty mind had been told to become a deep sea diver, as then the metal helmet and lead weights worn by that fraternity would at least have kept his body down if not his thoughts.

On the other hand I know of a boy that absorbed all and more knowledge than his foreman possessed in his three years' service. He is today a foreman in charge of quite a crew, but this boy got eighteen dollars a week in the third and last year of his apprenticeship and he was worth every dollar of it to the concern that employed him. It would have been a crime to insist on this boy completing his full four year term when there was nothing more that he could have been taught in that particular line of work.

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THE VALUE OF THE PRACTICAL EXPERIMENT

Some Valuable Advice Regarding the Reconciling of Theory and Practice.

By Russell R. Clarke.*

RUSSELL R. CLARKE

To determine the truth or falsity of the statement that a cat has nine lives, a curiously inclined youngster experimented on the family pet. On an empty stomach and in a dark room he found ample time for a definite summing up. No doubt about it, the cat was dead once and for all and the boy—willing to be. But the boy was ahead of the game at that. In a very practical way he had disfranchised his mind of a very practical doubt, which is some item, even in the affairs of men.

Much of human knowledge traces to experiment. Many things, both practical and scientific, have been thus established. The discovery of America was the result of experiment. The world was proven to be round by "rounding" it. Liquids were declared incompressible by filling a silver ball and subjecting it to enormous pressure, while their power to transmit their own pressure, an advantage resorted to in every assembled mold, became an indisputed fact in the bursting of a keg by a column of water.

Applied science owes much to experiment by which it has been explored and to which it offers much for fuller exploration. Especially is this true in those branches applying to the metal trade. So much so indeed that it is scarcely exaggerative to assume that at least 40% of the truths of chemistry, metallurgy, foundry and plating room practice have been thereby derived and remain similarly to be added to. With respect to chemistry, the science itself can be regarded the outcome of a great and failing experiment. Before chemistry was alchemy seeking the philosopher's stone and hoping thereby to turn the base into the precious metals. Out of its disappointments arose chemistry declaring the absolute oneness of an element and the impossibility of changing any one into any other.

The history of every alloy began in either accident or experiment, mostly experiment. Take any one, trace it back and you will most likely find it originating with somebody trying something to see how it would work out. Each of the many combinations constantly observed in copper, tin, lead and zinc represent little more or less than a practice arising from a trial. Manganese bronze, aluminum bronze, nickel bronze, phosphor bronze, Delta metal, German silver, and all began practically in the same way. It was simply a case of not knowing and trying in order to find out.

Early practice recognized mainly two classes of base metal alloys, the copper-tin and the copper-zinc, whence the old dictionary definition of bronze and brass, respectively. Supplementary elements and transgression came through experiment instituted in the interests of a more satisfactory product, thus copper and zinc, two to one, produced a yellow brass more or less lacking in individual and finishing qualities. Addition of ½ of 1% lead and tin each yielded improvement, so good yellow brass now reads copper 66, zinc 33, tin ½ and lead ½ parts. Primitive manganese bronze consisted merely in the addition of manganese to the copper-zinc or copper-tin-zinc alloys. It now embodies copper, tin, zinc, aluminum, manganese and iron, each added element being experimentally reckoned with in advance of general acceptance.

The evolution of an alloy is an interesting study. It gives us a line on the trend of thought and the direction of effort. It also enlightens us on the functions of the different constituents of an alloy—and that is the most valuable knowledge we can possess concerning it. Further, it makes clear the advantage or disadvantage of the elements experimented with. Many of our most staple alloys are offspring of a common parentage. Time was when copper 90, tin 10 answered many purposes. It is a hard, close-grained alloy possessing little power to resist or correct the evils of oxidation. To slightly modify rigidity and deoxidize, some one tried 2% zinc and 88, 10, 2 became the better and altered product. In opposition to friction and wear and in the interests of greater plasticity some one else tried adding 10% lead at the expense of copper and 80, 10 and 10 took its place among the standards of usage. Being primarily a bearing alloy and quite advanced in low-degree melting constituency, this 80, 10, 10 alloy could not well abide what it was forced to accept, namely serious oxidation. Zinc was out of the question, so experiment came forth with phosphorus and gave us phosphor bronze in copper 79, tin 10, lead 10, phosphorus 1. Desire for higher lead and its impossible attainment on an 89 part copper, 11 part tin basis prompted a series of most exhaustive experiments evaluating the 91 part copper, 9 part tin basis in the now well-known 78, 7, 15 alloy. These figures marked the accepted limit of lead control in copper-tin combination. Though a radical departure from its 10,-10 associate, it nevertheless failed to satisfy a rising demand. Lead was fast coming into popular favor. It had much in cost and apparently considerable in accomplishment to endear it to the consumer. The notion was—and in part justified—that service improved as tin receded and lead advanced. To the control of lead, experiment was started anew and along different lines. The result was a more definite understanding in the premises by virtue of which the liabilities of nickel, ferromanganese, galena, red oxide of mercury and different other conciliatory or incorporative agents were experimentally derived.

Now what happened in copper-tin occurred also in copper-zinc only in a more diversified way, and what came about in alloy constituency appeared also in every other related detail of foundry experience. Foundry plan, method, equipment, practice and all have undergone a digression similarly accounted for. Were the argument in need of the support, without drawing heavily on anything but time and space, we might easily demonstrate that every forward step in foundry and plating room knowledge and practice has been more or less experimental. A single example will illustrate. In recent years attention has been directed to the effect of virgin metal impurities or foreign ingredients on alloy status. By careful test involving the assured presence of those most common

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impurities native to different elements their effects have in different instances been definitely determined and protective specifications been formulated to either their limitation or exclusion, so that even the foundry purchasing department shares in the beneficence of experiment.

Thus far we have importanced the subject mainly on its material advantage, admittedly quite significant. But its true worth cannot be thus ultimately determined. Attaching to it is an absolute value greater than and utterly independent of these material gains. Not all experiments have been materially fruitful to practical purpose. Some have not even been successful to any purpose. The element magnesium has been tried as a deoxidizer. As such its ability has been unquestionably established. Weighing against its advantage, however, is its tendency to produce brittleness in the alloy in lieu of which its application involves either questionable or extremely cautious procedure. To practical purpose candor will evaluate it practically fruitless. Along this line other highly oxygenating elements have been tried and in some particular or other found wanting; yet for this sane reason cannot adjudge the effort an absolute failure. Nothing is failure that adds to the certainties or reduces the doubts and uncertainties of experience widening in consequence of its activity. An experiment without a consequence is an absurdity. We sometimes hear men say they tried a certain thing but it didn't amount to anything. That's the absurdity of the affair. It amounted at least to either a certainty of the thing's worthlessness or a broad knowledge of fact and principle by which to try it again. It amounted to more than that. We never dig for one thing but that we unearth some other along with it. To overcome shrinkage in an aluminum casting the author once tried the effect of molten lead in the head "pressure sprue." He had it all figured out on a specific gravity basis and used a neat fitting disc core to part the molten lead and aluminum in the sprue, thinking thereby to subject the casting to a uniform and constant liquid pressure throughout the casting's every stage to solidity. In "shaking the casting out" we found the lead at the "bottom" of the gate instead of the top. By virtue of its own pressure and suspended liquidity it had strained through the core and worked its way bottom-ward through the congealing aluminum. Materially the experiment was a failure but we had a new idea on the penetrating power of lead and the utter uselessness of ever trying to alloy it with aluminum on its own responsibility.

We once heard it said that the days of miracles are over because people don't need miracles any more. It will be a long time before that can be said of experiment. Its metallic field of usefulness is greater today than ever. To chemistry are known some 50 metallic elements. To practical purpose we have knowledge of alloying, but practically 12 of them and we are far beneath the high tides of possibility even along these known lines. The element aluminum has 100% greater efficiency and range in alloying today than 30 years ago, and we have little doubt that we are still many hundred per cent beneath its actual capabilities. In a sense more or less prominent the same can be said of all elements to whose mixing present practice applies. The naked fact is we are yet little men in a big business. None of us nor all of us together know very much about it. We have covered but a small area of the illimitable expanse and the more we discover the more we find to be discovered. Like Newton, we have picked up but a few shells on the strands of truth's great ocean.

That successful experiment is necessarily a technical affair closed to practical effort is a misconception. Its material value depends strictly on the practical application and usefulness of its disclosures wherefore its execution involves an extremely practical piece of business, an ultimately foundry piece of business, what occurs in the laboratory or settles with the deductions of abstract reasoning reduces to absurdity in the contrary findings of practical and everyday foundry experience. The logic of practice is more sound than the logic of theory and makes the practical the great field of efficient experiment. But the technical man is not thereby to be ruled out of the affair. Rather is he to be admitted to it because at heart and in principle he is of all men the most practical. He will see more and more clearly, proceed more intelligently, conclude more justly and record more faithfully; only the experiment and its advantage exists independent of him and is open to all effort, practical or technical.

Of all knowledge possessed by men, that gained by experience is the best known and most valuable. Information derived by reading, observation or conversation, though always valuable, is more or less abstract and not always thoroughly understood. That gained by experience gets into our mental system by a thoroughly digestive process, is readily and intelligently absorbed and yields the greater advantage.

An experiment is an experiment in the making only. Once made, it is a part of our experience. It may be only a small part, ill-shaped and fitting; compared with other men's or the aggregate it may appear an estranged atom, yet it is a part, an edge to stand us good advantage in every after-phase of effort falling tangent to it.

We learn and understand things more thoroughly by supplementing with experiment our abstract conception of them. In obedience to this principle the higher institutions of learning have their experimenting equipment in order to perfect students' understanding of great truths taught. To demonstrate a proposition is to better understand it, to verify a fact, the surest way of clinching it.

No sanely practical mind will question that the actual use of knowledge is the great medium to its expansion and better understanding. Herein lies the true and absolute value of the practical experiment on things abstractly known or conceived. To Brown and Smith, Jones remarks that a very small percentage of aluminum will improve the "running" tendency of yellow brass in making uniformly thin castings. Neither are in material need of the information. Brown merely remembers it, that's all. The next day Smith goes down in his foundry, has a long thin strip molded up, adds a small piece of aluminum to a pot of yellow brass, pours the mold, and follows the experiment through every detail of its consequences. Now Brown and Smith know the same thing told by Jones, which of the two do you suppose knows it the better?

Some foundrymen do not know how to make an experiment. The reason is they never made one. On their own hook we seriously doubt that they ever made anything else in their foundries. One thing is certain, the general fund of foundry information has nothing with their label attached.

If you hear something in connection with your foundry business and are not sure of it, try it. If in the interests of results you think a long-time standard practice ought to be changed, change it and see how

it works. If you have a notion that a certain combination of metals would make a rattling good mix, hook that notion up to a practical experiment and make sure of it. If some idea of problematical consequence infests your brain, don't worry your head off wondering about it, interest yourself in the practical experiment and see about it. For a positive fact we know a man who claims to have figured out the Walschaert valve-motion gear long before it ever did service on a Pennsylvania locomotive. He may have beaten Walschaert to it mentally but Walschaert beat him to it experimentally and—well, that's the difference.

The practical experiment is your medium to a bigger, broader, more up-to-date, better informed foundryman. By it you can turn the current of other men's experience into channels of your own. You can do it quite efficiently in this way: Make the trade magazines a vital part of your foundry experience. Read them through thoughtfully according particular attention to the questions and answers department because that represents the actualities of difficulty and knowledge dissolving it. To your surprise you will find a great mass of material from which to draw on for experiment. In reading, make a note of those items foreign to your experience, and within your experimenting range, get the facts and conditions well fixed in your mind, then test them out in your foundry. Now that may seem a uselessly expensive thing to do, but it isn't. It isn't necessarily an expensive affair and even though it were it is worth all it costs. It is a test for the accuracy of information. It makes for a broader knowledge of things, a wider range of experience, the getting of which is cheap at any cost.

To demonstrate the practicability of the idea—and we have found it preeminently practical—we will select four representative questions and their answers to be found in past issues of the trade magazines.

I. Wanted—An acid bath that will cleanse and bring out the color of composition castings.

Answer.—An acid bath in general use is: Nitric acid 10 gallons, sulphuric acid 4 gallons, water 2½ gallons. Answer supplemented with instructions and comments.

II. Can you furnish us with a good composition of phosphor bronze for springs and bearings?

Answer.—For springs—Copper 95%, tin 4.5%, phosphor tin (5%) .05%. For highest strength—Copper 90, tin 9, phosphor tin (5%) .01. For medium strength—Copper 80, tin 8, lead 10, phosphor tin (5%) 2. Answer supplemented with instructions and precautions.

III. Wanted—Method to overcome sand cutting and washing by molten alloy—copper 85, tin 5, lead 5, zinc 5.

Answer.—Full instructions given on composition of facing and method of using it along with suggestions and precautions.

IV. Wanted—Ways and means to prevent burning in of cores used in making heavy phosphor bronze castings.

Answer.—Core mix given and full instructions on preventive measures.

As already stated, these questions and answers are representative and suggestive in nature of the great mass of information circulating through these intermediary channels. Their susceptibility to practical test and the simplicity of its execution are so readily apparent as to obviate further comment.

The magazine articles will also be found accommodating and valuable to this purpose. A single example will suffice to illustrate. Personally we never had experience in making "slush" castings and possess no familiarity with methods pertaining thereto, except that we have quite recently attained. An interesting and explanatory article on the subject lately came to our notice. We read it and decided to try the thing for the sole purpose of perfecting our knowledge of the affair abstractly conceived. It was a rough experiment, but it helped a whole lot. Out of a piece of gas pipe we roughly improvised a slit mold, tried pouring the zinc in and back out again and derived profit therefrom. For further experiment we have under way at the present time preparations for more efficient equipment and look forward with confidence to fuller revelations. We may never need the experience and then again we may. At any rate, it will never do us any harm.

Besides suggestions derivatively external, in the daily routine of his own effort every foundryman will find much to engage his experimental attention. Experience, however extended, will never cover the all of related truth and possibility. There will always be something left to strive and struggle for. Every day in a foundry is an opportunity to add to its knowledge of certainties, to close some mental argument, dissolve some doubt, or iron smooth some rough course of indecision. The first law of efficiency is to know. If you don't know, find out. Find out for yourself and you'll know the more and the better. A foundry foreman was shown an ornamental casting of deep yellow and asked to duplicate its color. He tried six times. The seventh time he got it and along with it a knowledge of coloring effect in copper, tin, lead, zinc, aluminum and manganese scarcely possible to exceed. In earlier experience in molding we remember differing with a foreman on the possibility of getting a good casting with a green instead of a dry sand pocket core. By permission we tried it. We died hard but knew more after the crepe was up.

Much of past foundry experiment has been blind and indefinite. The object was plain but the means to it largely problematical. The attainment of desired results may be said to have been more or less accidental. Men tried different things without knowing exactly why and kept on trying until they struck the right thing. We admire them for their patience and have to thank them for our own more favorable conditions. They paved the way to a new era of experiment. The shut-your-eyes-and-trust-in-God policy is fast passing. Men try things today on a broader basis of knowledge, a more logical and assured hypothesis of consequence. Intelligence dominates method and results are definitely and accurately determined and recorded.

Such is the status of present-day experiment, scientific yet simple, technical yet pre-eminently practical. It's the gateway to new and fuller accomplishment and stands closed to no man. To get the most out of your own and other men's thought, with your own hard effort buy it, then try it.

RIVER PIRATES STEAL METAL.

The arrest a few days ago of a New York harbor pirate who made a practice of stealing tug boats, running them to a secluded spot and stripping them of brass and copper fittings, failed to discourage others addicted to that pastime. The tugboat *Mastodon*, left unguarded at the pier at the foot of Congress street, Brooklyn, at midnight was missing when her captain and crew went to take her out on the morning of May 5.

The tug was finally located on a shoal and in a sinking condition off Greenville, N. J., a Jersey City suburb. She had been stripped of her brass and copper fittings.

TESTS OF TIN PLATING BATHS*

Some Interesting Data Not Heretofore Published.

By Frank C. Mathers and Barrett W. Cockrum.†

This work was undertaken at the suggestion of Dr. W. D. Bancroft, of Cornell University, who is chairman of a committee appointed by the American Electrochemical Society, in April, 1913, to investigate the problems of electroplating. Attention was directed towards tin on account of the great number of different baths for tin plating and the absence of any bath which is widely accepted by platers as satisfactory. This indicates that the baths, as described, do not produce satisfactory deposits.

The demand for the electro-deposition of tin is very small on account of the easily executed process of tin-coating metals by dipping in molten tin. However, the lack of a really satisfactory plating bath makes the amount of electro-deposition of tin still smaller.

MANIPULATION.

Each of the various tin baths described by Kern[1] in his review upon tin plating was prepared and electrolyzed at 0.4 amp. per sq. dec. (3.6 amp. per sq. ft.) under the prescribed conditions of temperature, acidity, stirring, etc. Two anodes of commercial tin, one on each side of the beaker, were suspended by iron wires in alkaline baths, by lead wire in complex baths where anode corrosion was good, and by platinum wires in the others. The baths were stirred occasionally with glass rods during the course of the electrolysis. The cathodes were of iron or thinly rolled pure tin. In each case electrolysis was continued constantly for two weeks, the cathodes being replaced by new ones whenever crystalline or spongy growths seemed to produce short-circuits.

CLASSIFICATION OF TIN BATHS.

The baths for tin plating seem to fall into three principal classes, as follows:

1. Tin salts of mineral acids, with or without other inorganic salts or organic addition agents.
2. Alkaline baths, as sodium stannite, with or without other salts.
3. Complex or double salts.
4. Alkaline sulphides.

These latter were not tried in this work.

1. TIN SALTS OF MINERAL ACIDS.

Many of the difficulties in tin plating are unavoidable because they lie in the specific inherent properties of tin salts and in the pronounced tendency of metallic tin to be electro-deposited in a loosely crystalline or a spongy condition. Stannous salts easily oxidize in the air with the formation of basic insoluble compounds, unless an excess of strong acid is present. The sulphate, being almost insoluble, and the nitrate, being unstable, cannot be used. This leaves, among the cheaper salts, only the chloride or the fluoride and no advantage seems to lie in the use of the more troublesome fluoride. A bath of stannic salts is reduced at the cathode by the current and a constant deposition of tin is not attained until a certain ratio of stannous to stannic salt is present, which ratio is theoretically the same as the ultimate composition of a bath made from stannous salts. Hence a solution of stannous chloride containing hydrochloric acid and perhaps such other salts as sodium chloride, ammonium chloride, etc., is the simplest and cheapest bath. Hydrofluoric, perchloric, fluoboric, and fluosilicic acids give soluble stannous salts, and they could be used for plating if they gave satisfactory deposits, although they are more expensive. An extensive study[2] has already been made in this laboratory of baths containing many combinations of tin salts of the mineral acids, both with and without organic addition agents, but in no case was it found possible to obtain a solid, firm deposit that was free from coarse or rough crystals. The deposits were masses of bright glistening crystals which adhered fairly well in some cases. This class of baths is of no value where a solid, uniform deposit is desired, a fact that seems generally recognized, as is shown by the absence of baths of this kind among those recommended for plating purposes.

2. ALKALINE BATHS.

Tin salts readily dissolve in an excess of sodium hydroxide, forming a clear solution which remains free from precipitate and which would be satisfactory as the basis of a plating solution if such baths yielded firm, solid deposits. The voltage required by these baths is high, and the anode corrosion is low in many of them. A very large proportion of the tin baths which have been recommended for plating belong to this class, which may be further divided as follows:

(a) Sodium stannite or potassium stannite, without the addition of other salts.—The baths[3] which were tried contained from 1.2 to 1.4 per cent of tin as stannous chloride and from "sufficient alkali for a clear solution" up to 6 per cent of potassium or sodium hydroxide. In all cases the deposits were masses of small, bright crystals which were worthless as a protective coating.

(b) Sodium or potassium stannite and tartrates.—The addition of tartrates[4] to the alkali stannite baths did not improve the character of the deposit, which was spongy from the bath containing only 1.3 grams of fused stannous chloride per liter but crystalline from the bath containing 3 grams of the same salt per liter.

(c) Sodium or potassium stannite and potassium cyanide, with or without other salts.—The various baths[5] are as follows:

KCN	K_2CO_3 or Na_2CO_3	$SnCl_2$ (cryst)	KOH or NaOH	SnO_2	$Na_2P_4O_7$ (cryst)	$Zn(C_2H_3O_2)_2$
1	82.5	...	5.5	17.5	...	1
10	...	11	to	...	...	..
1	80	1.5	dissolve	...	...	..
10	110	2.5	....	...	...	..
111	...	1.2	7.5	...	111	..
35	...	7.5	111	...	...	..

None of these gave good deposits of any considerable thickness. The following general observations were made:

(1) With large amounts of carbonate and little or no sodium hydroxide, the anodes dissolved so poorly that the tin in the bath was soon exhausted, after which both electrodes gassed vigorously. These baths gave good looking, bright deposits which were very thin however. The current yields were very low, as was indicated by the quantity of gas evolved at the electrodes. It would require an extremely long time to obtain a deposit of any reasonable thickness from such a bath.

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[1] Trans. Am. Electrochem. Soc., 23, 199 (1913).

[2] Mathers and Cockrum: Trans. Am. Electrochem. Soc., 26, 133 (1914).

[3] Baths Nos. 6, 7 and 8 in Kern's Report. *Loc. cit.*

[4] Baths 9 and 10 in Kern's Report. *Loc. cit.*

[5] Baths 11, 12, 13, 14, 15 and 16 in Kern's Report. *Loc. cit.*

(2) Potassium cyanide seemed to be without much influence upon the crystalline structure of the cathode.

(3) Very large amounts of the potassium cyanide must be accompanied by correspondingly large amounts of sodium hydroxide, otherwise the tin is precipitated as a sludge in the bath and, upon electrolysis, little tin is deposited upon the cathode.

A bath containing 9 per cent potassium hydroxide, 0.35 per cent potassium cyanide, 0.75 per cent potassium bitartrate, and 0.75 stannous chloride is used commercially[6] in barrel plating. The bath is run hot (70°C.) and a thin deposit is obtained. At intervals more of the potassium cyanide must be added. Experiments with this bath in a still solution indicated that thick deposits could not be obtained because of the formation of projecting crystals. However, very thin deposits appeared to be good, because the crystals were too small to be readily seen. The tumbling in the barrel would compact the deposit into a more firm and solid coating.

(d) Sodium stannite and sodium thiosulphate.—The baths[7] contained, in per cent, as follows:

$Na_2S_2O_3$	NaOH	$SnCl_2$	NaCl
7.5	12.5	5	..
6	12	3	..
1.5	9	3	1.5

The baths with 6 per cent or more of the sodium thiosulphate gave firm, finely-crystalline deposits, which became rough on continued electrolysis. A fine black precipitate was formed in the bath when the sodium thiosulphate was added. The deposits from these baths were the best obtained from any bath described by Kern. The deposits were dark but became bright and metallic after buffing. On continued electrolysis the deposits became rough and nodular, but projecting roughly adhering crystals were absent. Solutions at room temperature worked better than at 60°C. (140° F.). The voltage was 1.2.

3. COMPLEX OR DOUBLE SALTS.

(a) Pyrophosphates. The Roessler bath[8], or modifications of it containing 1 to 3.7 per cent of sodium pyrophosphate and 0.1 to 2 per cent of fused stannous chloride, is highly recommended by various writers. The deposit from a hot solution is said to resemble silver. We are aware that this bath is used commercially, but nevertheless the deposits in our experiments were spongy and non-adherent. It seems that only thin deposits are produced, and that tumbling or scratch-brushing must be resorted to in order to give the deposits a bright, metallic appearance. Two of these baths, which are used commercially,[6] are:

(1) Six parts of sodium pyrophosphate to 1 part of fused stannous chloride. It is said that the concentration can vary within rather wide limits without affecting the deposit very much.

(2) Three per cent sodium pyrophosphate, 0.75 per cent fused stannous chloride and 0.2 per cent alum.

It is claimed that these baths may be run either hot or cold, but that only a low current must be used. It is recommended that a saturated solution of fused stannous chloride in sodium pyrophosphate be added at intervals to compensate for poor anode corrosion.

(b) Stannous Ammonium Oxalate.—A deposit consisting of long, needle-like crystals was obtained from a bath[9] containing 2 to 3 per cent stannous chloride, 5.5 to 6.5 per cent ammonium oxalate and 0.3 to 0.4 per cent oxalic acid. The completed bath was heated to boiling before using. The addition of peptone[10] to a modification of this bath containing more tin, prevented the formation of loose crystals and produced by far the smoothest, firmest and thickest deposit of tin which was obtained from any tin bath.

(c) Acid Tartrate.—A bath[11] containing 6 per cent potassium hydrogen tartrate and 1.5 per cent stannous chloride gave a mass of small, loosely adherent crystals. After two weeks of continuous electrolysis, the crystals became much smaller and showed a tendency towards sponginess. The anodes dissolved unevenly.

TINNING BY CONTACT.

The various dip or immersion solutions for tinning by contact without the use of outside current gave bright deposits of tin, thereby confirming all that is said of them in the literature and in the books upon plating.

SUMMARY.

The various baths for tin plating, which were described by Kern,[1] were prepared and electrolyzed for two weeks with a current density of 0.4 amp. per sq. dec. (3.6 per sq. ft.) under the conditions recommended.

In no case was a satisfactory deposit obtained, although the sponsors for the various formulas have made roseate claims for them. In most cases the deposits were masses of more or less adherent crystals, although in some cases they were spongy.

Among the baths described by Kern, the Beneker bath[12] containing 25 gms. of sodium hydroxide, 10 gms. stannous chloride and 15 gms. of sodium thiosulphate in 200 cc. of water, gave the smoothest, firmest deposits of good thickness. The deposits were dark in color but could be scratch-brushed to a bright, metallic appearance. The bath seemed to gradually deteriorate, the deposit becoming black and at last non-adherent. This bath is considered to be far below the quality desired for electroplating.

Some of the baths containing combinations of potassium cyanide and alkali carbonates or hydroxides with a little stannous chloride gave bright deposits, but there was a simultaneous liberation of hydrogen, and anode corrosion was poor. Such thin flashings hardly deserve the name of tin plates.

The stannous ammonium oxalate bath containing peptone as an addition agent[10] gave a smooth, firm, finely-crystalline deposit, the best obtained from any bath.

[6] Private communication.
[7] Baths 17, 18 and 19 in Kern's Report. *Loc. cit.*
[8] Bath 2 in Kern's Report. *Loc. cit.*
[9] Bath 1 in Kern's Report. *Loc. cit.*

[10] See Mathers and Cockrum: Trans. Am. Electrochemical Soc., 29, —— (1916).
[11] Bath 5 in Kern's Report. *Loc. cit.*
[12] U. S. P. 921,943; Met. Chem. Eng., 7, 285 (1909).

CUSTOMS DECISIONS.

The United States Court of Customs Appeals in a recent decision settled the status for dutiable parts under the present tariff of a large variety of plated articles. The specific goods under which the decision was given related to metal frames for handbags. The Collector of the Port assessed 50 per cent. duty as plated articles, while the importers claimed 20 per cent. as metal articles not plated with gold or silver. The court affirmed the decision of the Collector that the articles should be assessed 50 per cent. duty. The decision, which was of a sweeping character, held that in order to bring articles under the plated provision of the law it was not necessary to show that the whole surface was plated or that any particular percentage of the surface was plated. It was enough, said the decision, that there was a substantial portion of the article plated.

THE MANUFACTURE OF ADMIRALTY GUN METAL IN ENGLAND

SOME NOTES REGARDING THE PRODUCTION OF THE BRONZE 88 COPPER 10 TIN AND 2 ZINC NOW SO MUCH IN DEMAND FOR WAR PURPOSES.

BY H. S. PRIMROSE, M.T.M.*

(Continued from April.)

CALCULATION OF CHARGES.

The calculation of the weights of the different metals required as components of a charge to make a cast of gun metal from, say, a 60-pound crucible, is a very simple matter if only pure materials are to be used. Thus the proportions necessary for the 88-to-2 mixture, making allowance for 0.5 per cent. of zinc being lost as oxide would be—

Copper	88 × 0.6 =	52.8	say	52¾ lbs.
Tin	10 × 0.6 =	6.0	"	6 lbs.
Zinc	2.5 × 0.6 =	1.5	"	1½ lbs.

Suppose the charge is to be made up for a hundred pound pot, and it is required to use up a small proportion of high grade scrap which has been melted and found to be suitable for use after analysis. Given that the analysis shows the composition of the remelted metal to be:—Copper, 85 per cent.; tin, 8 per cent.; zinc, 6 per cent.; lead, 1 per cent.; it is necessary to find the proportion of pure copper and tin which must be added in order to give the final composition of the alloy as nearly 88-10-2 as possible to meet the Government requirements, which allow of a deviation of not more than 1 per cent. from the above mentioned figures, and a lead content of not more than 0.5 per cent. The first item to consider is the excess of zinc, which must be reduced in each 100 pounds of the mixture from 6 lbs. to about 2½ lbs. This means that for each 100 lb. of scrap metal ingots used there will be an excess of 3½ lbs. of zinc, and to balance this there will be a deficiency of 2½ lbs. of zinc in each 100 lbs. of pure copper or tin added. The proportion. therefore, of combined pure metals to scrap will be the inverse ratio of these last two values, namely:—3.5 to 2.5, or 7 to 5, or 140 to 100. So that to each 100 lbs. of scrap ingots the combined weights of copper and tin ingots which will be necessary to add will be about 140 lbs. We should thus aim at a total mixture of about 240 lbs., the 100 lbs. of scrap metal in which will yield 85 lbs. of copper and 8 lbs. of tin. The total weight of copper required to be present in 240 lbs. of alloy will be 240 + 0.88 = 211 lbs., thus there falls to be added 211—85 = 126 lbs. of copper. The total weight of tin required is 240 + 0.1 = 24 lbs., leaving 24 — 8 = 16 lbs. to be made up from pure ingot metal. The total of copper and tin is thus 126 + 16 = 142 lbs., which is in close agreement with what would be used in practice to allow for a slight loss of tin in melting, and also to allow the copper percentage to increase due to the loss of zinc in melting. The weights of metal required for the 100 lb. charge is now got by multiplying the above proportionate weights by the fraction 100 ÷ 240 = 0.417, so that we get the copper required as 126 + .417 = 52 lbs.; tin. 16 + .417 = 7 lbs. and melted scrap, 100 + .417 = 41 lbs. In order to prove the accuracy of this calculation and also to arrive at the probable percentage composition of the resulting alloy, these proportions may be extended as follows:—

	Copper.	Tin.	Zinc.	Lead.
From 41 lbs. melted scrap	34.85	3.28	2.46	0.41
From 59 lbs. copper and tin ingots	52	7		
Calculated total for 100 lbs.	86.85	10.28	2.46	0.41

These figures also give the calculated percentage, but as a result of melting this mixture the loss of zinc, amounting to about 0.5 lb. in the 100 lbs., and a small amount of tin as dross, say 0.3 lb. will be sufficient to raise the percentage of copper to within the specified limits. The actual analysis of such a mixture as that above worked out was found in practice to be:—

Copper	87.7	per cent.
Tin	10.1	"
Zinc	1.85	"
Lead	0.35	"

REVERBERATORY FURNACE MELTING.

When the charge has to be calculated for the melting of gun-metal in a large reverberatory furnace, which is capable of holding from five to seven tons of the alloy, the mixture of metals used may be more complex, and the proportions of the various materials worked up may be more or less arbitrarily selected. Thus, suppose we have in stock about equal parts of heavy shop scrap (consisting of runners and gates and sawn-off heads and borings), got from the turnery and machine shop working on the Government alloy, which have been carefully freed from "tramp" iron by passing through a magetic separator, and also about three times as much bought-in scrap which has been carefully selected, run down into ingots and analyzed. The problem becomes fairly simple and it is even possible with a little experience to determine the requisite proportions of copper and tin ingots by inspection. Instead of working in pounds, it is more convenient for large charges to take as units the quotient of cwts. per cent. Thus to take an actual example of making up a charge sheet for a seven-ton furnace in which it was desired to use one ton each of shop scrap and clean machine borings and to utilize about three tons of the known ingot metal, it is only necessary to determine the weights of copper and tin ingots to be added to make up the total to 140 cwts. Setting the percentages out in a convenient table, the charge works out as follows:—

		Copper.		Tin.		Zinc.		Lead.	
Material.	Weight, Cwts.	%	Cwts. %	%	Cwts. %	%	Cwts. %	%	Cwts. %
1. Borings	20	87.8	1,756	9.7	194	2.0	40	0.5	10
2. Shop scrap ...	20	87.9	1,758	9.6	192	2.0	40	0.5	10
3. Ingot metal...	60	85.5	5,130	8.5	510	5.0	300	1.0	60
4. Copper ingots.	35	99.9	3,496	...	...	...	...	...	..
5. Tin ingots....	5	....	.....	99.9	499	...	...	...	..
Total	140	....	12,140	...	1,395	...	380	...	80
Calculated analysis	..	86.7	.....	10.0	...	2.7	...	0.57	..
Actual analysis..	..	87.8	.....	9.7	...	2.0	...	0.5	..

Naturally if the shop scrap or melted ingot metal showed a much lower content of copper and tin, then the proportion of these which could be worked off with copper and tin ingots would be smaller and the total of the latter would have to be correspondingly raised to keep the zinc and lead down to the requisite percentages.

CASTING TEMPERATURES.

The question as to what is the best temperature at which to cast Admiralty gun-metal cannot be answered by quoting one definite temperature. The reason for this

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is that the correct temperature for one class of work would be completely wrong if used for another size of casting poured in a different way. Thus if small repetition work is desired with a lean smooth skin, then it is advisable to cast the metal at as high a temperature as possible, consistent with the necessary precautions needed to prevent it from being burnt or oxidized to a harmful extent in the furnace. Such a temperature would be in the vicinity of 1,100° cent. (2,012 F.). To prevent defects in the castings of this small nature, special precautions must be taken to ensure that a sufficiently refractory facing mixture is employed, and that very thorough venting of the mould is performed so as to obviate scabs, rough skin and even blow-holes. This point will be more fully dealt with later in this series of articles.

As the size of the castings increases, the proper temperature at which to pour the metal gradually decreases, so that for medium sized castings having no very great difference in the cross sectional areas at various points, and weighing between 5 and 15 lbs., the lower temperature of between 1,040° and 1,070° C. (1,900° and 1,960° F.) six will be sufficient. For extremely heavy work in which the total weight of the casting may be several hundred weights, and in which there are no fine or intricate cores to negotiate, the best casting temperature need not be much above 1,000° cent. (1,832° F.). Castings may, of course, be run at an even lower temperature than this, but the inadvisability of doing so must be obvious when it is understood that the alloy commences to solidify about 1,010° cent. (1,850° F.), and it is impossible to expect good castings from metal which is in a partly solidified condition during the pouring process. In the case of heavy castings which have considerable variations in thickness at different places and in which there may be somewhat intricate cores, it is essential to cast the metal at a fairly high temperature, say in the vicinity of 1,080° cent. (1,975° F.) so that the metal will run fairly freely in the finer parts of the mould.

Another item which must be taken into consideration when determining the casting temperature which will be most suitable is whether the mould has been made in green sand or in dry sand, or if any considerable part of the casting is made to come in contact with a chill surface. Higher temperatures of casting are allowable with green sand moulds than with dry sand moulds, which do not conduct away the heat of the metal so quickly, and which therefore allow the metal to solidify and cool more slowly. In the case of chills, there is more latitude permissible in the casting temperature, as there should always be a sufficient mass of metal in the chill to take away the heat from the casting at such a rate as to cause both rapid solidification and rapid cooling of the metal through the critical range. It will be shown later what profound influences on the physical structure and properties are exerted not only by the rate of cooling after solidification, but also on the rate of solidification itself, and through what temperature range this had to take place.

SOLIDIFICATION OF GUNMETAL.

When the charge of gunmetal is completely melted in the crucible all the constituent metals are intimately mixed together and combined with one another in the form of solutions, but when the metal is cast and allowed to cool slowly, very complex changes take place during the solidification of the alloy. These changes have been closely studied, and they have been mapped out in such a way as to be readily understood by means of the accompanying diagram, Fig. 1. This combination is made up from data which has been amply verified as to the physical, thermal and chemical changes which take place when a combination of the three metals, copper, tin and zinc is allowed to freeze normally, and also when various kinds of heat treatment are given to the ternary alloys. In plan the diagram is represented by an equilateral triangle (Fig. 2), and the composition of any particular alloy can at once be determined by referring its distance from the sides of the triangle to the scale of the drawing. Thus the point A in the diagram represents an alloy containing 80 per cent. of copper with 10 per cent. each of zinc and tin. Similarly B represents a 70-20-10 alloy,

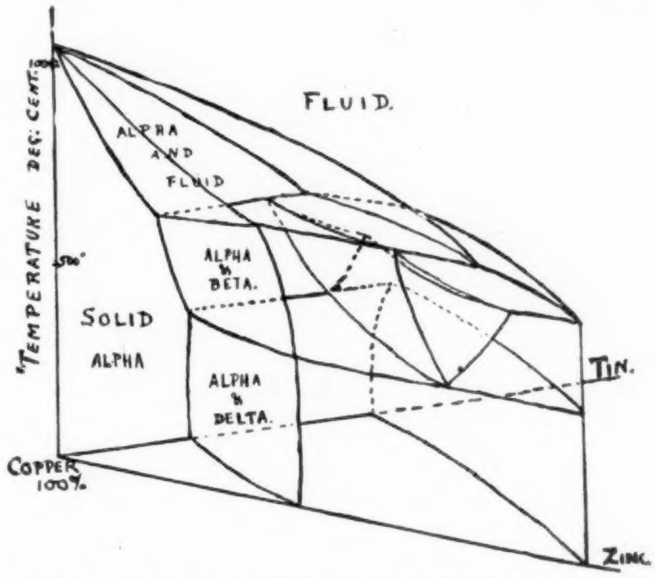

FIG. 1.—DIAGRAM OF CONSTITUTION OF COPPER-TIN-ZINC ALLOYS.

and C represents a 70-10-20 metal. The dotted lines across the diagram indicate the temperatures at which the alloys commence to solidify, and conversely the temperature at which the solid metal becomes completely fluid on heating. Thus the primary freezing point of A is 960° C., of B 905° C. and that of C is 850° C. In the same way the alloy of gunmetal composition is seen to have a primary freezing point of just under 1,000° C.,

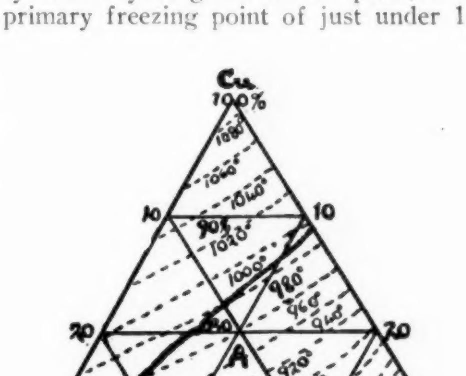

FIG. 2.—PRIMARY FREEZING POINT OF COPPER-TIN-ZINC ALLOYS.

and experiment has shown it to be about 996° C. A pure metal has only one melting point and one freezing point, in the case of copper at 1,085° C., but although gunmetal contains 88 per cent. of copper it can be cooled down to 1,000° C. and still remain completely molten. When it has passed below 996° C., however, it will not have become completely solid, as would copper when it

has passed below its freezing point. That is to say, these alloys have not a definite freezing point, but a freezing range, and some part of the gunmetal remains in a fluid condition until the whole mass has cooled down to 770° C., below which it is completely solid. During the time the metal has passed through this large temperature difference, viz., 226° C., a process of selective freezing has been going on, so that whilst the first crystals to separate out are rich in copper, the last portions to become completely solid are poorer in copper and very much richer in tin.

The first crystals which begin to form, usually at the outer surfaces of the casting, proceed to grow inwards in a direction mainly at right angles to the skin. Nearly all the zinc present in the metal remains in solution in these crystals right through all the subsequent changes, as does also a small proportion of tin. This first freezing impoverishes the still molten metal in the amount of copper it holds, and the tin is correspondingly increased. Subsequent growth of the primary crystals is augmented by layers of copper with an increasing tin contents, and the final portions of the alloy to solidify in the interspaces of the primary (alpha) crystals is known as the second or beta constituent, and may contain fully 25 per cent. of their weight of tin dissolved in the copper. If the alloy is now quenched suddenly, before it has cooled any further, these two constituents are retained in the alloy when cold, but during slow cooling the second constituent undergoes a structural change as it passes through the temperature range from 790° C. to 500° C., and when the temperature falls below 490° C. it has ceased to exist, as it then decomposes to form a mechanical mixture of the first constituent (alpha) and a third, which is known as the delta component and contains a still higher percentage of tin. This final separation of the beta into the first and third constituents is accompanied by volume changes, and hence arises the difficulty of getting completely sound casting of Admiralty gunmetal if the cooling is allowed to be so slow that the segregations of this eutectoid structure attain any considerable magnitude, or communicate with one another throughout the mass of the casting. The methods of obviating this fault, which is an accompaniment of low tensile strength and elongation, as well as of inability to withstand hydraulic pressure, are simple and effective. Either the cooling through the first critical range must be sufficiently rapid to keep the beta segregation small, or the metal must be subsequently heat-treated to re-dissolve the delta constituent and make the alloy homogeneous throughout.

MELTING PRACTICE—FURNACES.

The manager of a foundry engaged in making gunmetal castings must carefully consider the type of furnace which will prove most suitable and efficient for the class of work which is to be undertaken. When large quantities of small parts of repetition work are to be made, the size of cast is generally limited, and in this case it will be found convenient to instal a battery of ordinary coke-fired crucible furnaces. While there are a great number of patented designs on the market, the old-fashioned simple "pit furnace" or "pot-fire" is very difficult to heat, provided that it is properly designed and worked. Its size will vary with the size of crucible employed, and it should be made to hold only one at a time with as little clearance as can be arranged. Where circular or arch bricks are easily obtained, the circular form of furnace is most economical in fuel, because it is only the fuel which is in actual contact with the crucible which imparts the necessary heat to effect the melting. The corners filled with hot coke in a square built furnace represent so much waste heating power.

To ensure as perfect combustion of the coke as possible it is necessary to have a good draught. This is best produced by a stack of such dimensions as will freely carry off all the hot products of combustion, and of such height as will cause a good suction in each furnace communicating with the flues. A simple means of regulating the passage of the hot gases from the furnace to the flues connected with the stack is also an essential feature of the design, and care should be taken to operate this damper regularly, as in this way much loss of heat may be avoided. No less important is the air inlet to the furnace bottom, since if insufficient oxygen is provided, then the furnace becomes a gas producer on a small scale, and the escaping gases will be rich in carbon monoxide, each part of which represents a loss of two-thirds of the heating power of the coke from which it is formed.

A very common practice is to set crucible upon a firebrick stool so as to keep it raised above the fire-bars, and also to prevent it from falling to one side and spilling some of its contents as the coke burns down. The amount of coke consumed will depend on the quality of the fuel and the efficiency with which the furnace is being operated, but it is not uncommon to find that the coke used amounts to fully 50 per cent. of the weight of the charge melted. By means of an improved furnace bottom it is possible to reduce this with care to about 45 per cent., and at the same time to attain a considerable increase in the speed of melting, with a consequent saving labor. This saving is effected by eliminating the ordinary fire-bars at the bottom of the fireplace, and making the crucible sit directly upon a circular cast iron base in the shape of a frustrum of a cone, and perforated with a number of round holes. In this way the combustion of the fuel is made very perfect, and there is practically no carbon monoxide in the gases escaping to the stack.

Coke-fired furnaces are best arranged in a continuous battery or range, built compactly together, as in this way radiation losses are reduced to a minimum, space is economised, and cleaning of the ashpits is facilitated. Where heavy crucibles are used, it greatly reduces the labor by having the furnace tops arranged on the level of the working floor, a suitable pit being left to secure access to the ash-pit and fire-bars for baking purposes. A great advantage of the improved type of conical furnace base mentioned above is that the furnace can be readily cleaned from the floor level by simply inserting a rod with a T-head, through the central slot on the top of the conical base. By lifting and lowering it once or twice the ashes fall out between the furnace walls and the edges of the improver, which rests on the furnace ring by means of three equi-distant lugs or projections.

One of the chief objections to the use of pit furnaces sunk below the level of the floor is that heavy labor is entailed in lifting out the large crucibles filled with molten metal, unless some mechanical appliance is provided for drawing the pot. Of the many types of patented coke-fired furnace, one which deserves mention is the Swiss model* furnished with a double folding shell. This includes a small variable-speed motor-driven fan-blower, which delivers the low-pressure blast centrally into the chamber below the coke bed. The crucible rests on a stool supported on the blast pipe, and the top of the furnace is closed by a hopper-shaped cover which is capable of being raised, inverted, or lowered into the melting position. The cover also serves as a pre-heater for large pieces of metal, which, as the escaping gases pass round them, gradually melt down into the crucible below.

(To be continued.)

*This furnace was shown in THE METAL INDUSTRY, April, 1916.

RAPID NICKEL PLATING*

An Article Dealing with the Employment of Single Nickel Salts.

By Oliver P. Watts.†

During the greater part of the half century that nickel plating has been practiced, platers were content to follow in the footsteps of their forefathers and deposit nickel at the snail's pace of three to five amperes per square foot. A few years ago "rapid nickel salts," claimed to permit of nickeling at two to three times the usual rate were imported from Europe. These proved to be only mixtures capable of yielding more concentrated solutions than that enemy of progress, the "double sulphate," which for so long has masqueraded as the plater's friend. The American plater soon learned how to make up his own rapid solution, and as a result nickeling at ten to twenty amperes per square foot is very common today.

The most recent step in rapid nickeling, if nickel's twin-brother and rival, cobalt, may be included in this category, is the remarkable work of Kalmus and Barrows[1] in plating with cobalt at 150 amperes per square foot, turning out commercial plating of high grade in three minutes.

These achievements with cobalt suggested the desirability of obtaining similar effects with the cheaper nickel solution. In so far as the wonderful results of cobalt solution XIIIB depend upon its extreme concentration (312 grams of anhydrous cobalt sulphate, equivalent to 585 grams of the crystallized salt, per liter, or 7½ pounds per gallon) it should be possible to duplicate them with nickel, since its salts are equally soluble. It is in the matter of anode corrosion and in its absorption of hydrogen[2] that nickel is inferior to cobalt as a metal for electroplating.

The nickel anode becomes "passive" on the slightest provocation, and instead of all of the current dissolving nickel as is desired, a portion of it is spent in producing acid at the anode. Besides cutting down the efficiency of deposition, this acid causes hydrogen to be evolved in considerable quantity on the cathode, where some of it is absorbed by the deposit. Absorption of hydrogen by nickel renders it hard and brittle, and is likely to cause it to curl away from the metal on which it is deposited. The addition of a small amount of some chloride to the sulphate solution usually used for nickel plating is a well-known remedy for this passivity of the anode.

Previous experience with hot nickel solutions indicated their use for overcoming the difficulties just mentioned, since in a hot solution anode corrosion is greatly improved and absorption of hydrogen is lessened.

A 25-gallon (95 liter) hot nickel bath was used at 125 to 150 amperes per square foot (14 to 16 per sq. dm.), with great satisfaction, producing in five minutes a heavier deposit than is obtained in an hour from the usual "rapid" bath at ten amperes per square foot. In spite of the extreme current density the deposits were superior in quality and adherence to ordinary nickel plate. Since the electrical instruments and current supply were inadequate for working this bath to its full capacity, a portion was removed to an enameled pail where it could be tested on small cathodes.

This solution contains nickel sulphate (single salt), nickel chloride, and boric acid in the following proportions:

	Grams/Liter	Oz./Gallon
$NiSO_4.7H_2O$	240	32
$NiCl_2.6H_2O$	20	3
H_3BO_3	20	3

*A paper presented at the Twenty-ninth General Meeting of the American Electrochemical Society, in Washington, D. C., April 27-29, 1916.

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[1] Trans. Am. Electrochemical Society (1915) 27, 75.

[2] *Idem.* (1915) 27, 121.

At the outset the anodes were the same that have been used in the plating laboratory for a number of years, *viz.*, strips of electrolytic nickel. Later cast anodes of the same material were employed. Results of some of these tests are presented in tabular form.

Exp.	Temperature C°	Temperature F°	Time Min.	Amperes per Sq. Dm.	Amperes per Sq. Ft.	Ampere-Hours per Sq. Ft.	Deposit.
No. 10	67	153	5	31.7	295	24.5	Fine.
No. 48	71	160	5	47.6	422	28	Good.
No. 54	92	198	1	95.3	890	14.8	Fine.
No. 4	25	77	3	5.3	49	3	Fine.
No. 5	25	77	6	14	130	6.5	Mat, polishes well.

In no case was the deposit "burned." In No. 5 there was a vigorous evolution of gas, indicating a low current efficiency of deposition. Deposits from the hot solution were mat, but polished easily.

It is a matter of general observation that electrolytic deposits become rougher with increasing thickness; when comparing different plating baths it is therefore desirable to know the thickness of the deposits as well as their physical qualities. For the same current efficiency, the thickness of nickel deposited will be proportional to the ampere-hours per unit of surface. By a comparison of the ampere-hours per square foot in the accompanying table, the relative thickness of different deposits may be estimated. At 100 per cent efficiency one ampere-hour per square decimeter deposits 0.0123 mm., and 10 ampere-hours per square foot deposits 0.00052 inches, or 0.001 inch in thickness requires 19.2 ampere-hours. One hour at ten amperes per square foot, or ten ampere-hours, is considered good nickeling, and a common cobalt deposit by Barrows was 150 amperes per square foot for three minutes, or 7.5 ampere-hours. Judged by these standards the results shown in the tables are heavy deposits.

In order to secure samples from hot and cold solutions for direct comparison polished aluminum cathodes were used, from which the nickel was easily stripped.

DEPOSITS ON ALUMINUM.

Exp.	Temperature C°	Temperature F°	Time, Min.	Amperes per Sq. Dm.	Amperes per Sq. Ft.	Ampere-Hours per Sq. Ft.	Deposit.
No. 12	74	165	20	18.9	176	60.3	Fine, mat
No. 14	35	95	12	11.7	169	22.6	Rolled up, brittle
No. 15	38	100	22	8.2	76	27.9	Mat, tore in buffing
No. 49	71	160	5	24.2	225	18.7	Fine
No. 50	78	172	10	30.7	285	47.6	Fine 0.002 in. (0.05 mm.) thick
No. 53	98	208	25	15.2	141	60	Five successive deposits

Plating on aluminum brought out the difference between deposits from cold and from hot solutions. An excellent deposit was obtained from the hot solution in every case, which bore polishing without peeling from the aluminum, and when stripped from the latter proved of excellent physical quality. Most of the deposits from the cold solution rolled up and partly separated from the cathode while in the plating bath, and in the few cases where this did not happen the deposit was torn during polishing. No. 53 consisted of five successive deposits for five minutes, each coating being polished and immersed in the electric cleaner for ten seconds before re-

plating. It is 0.0025 inch (0.06 mm.) thick, and is harder than the usual deposit from a hot solution.

Current efficiency tests were made by reading the current on a Weston model No. 280 ammeter, and determining the weight of metal deposited in five or six minutes. Since a difference of three seconds changes the weight of a five minute deposit by one per cent, the results are subject to an error of at least this magnitude. Current efficiencies above 90 per cent are obtained in the hot solution at 20 amperes per square decimeter (190 amp. sq. ft.). It is evident from the tests that heating the solution and lowering the current density raises the current efficiency.

CURRENT EFFICIENCY TESTS.

Exp.	Temperature C°	Temperature F°	Time Min.	Amperes per Sq. Dm.	Amperes per Sq. Ft.	Ampere-Hours per Sq. Ft.	Cathode Eff. per cent.
No. 11	45	113	6	31.1	289	28.9	89.6
No. 13	29-40	84-104	6	31.1	289	28.9	19.4
No. 16	60-70	140-158	13	8.6	80	17.3	100.9
No. 46	25-28	77-82	5	19.4	180	15	31.7
No. 48	91-84	196-183	5	9.5	88	7.4	98
No. 51	77-73	171-163	6	26.4	245	24.5	100.5
No. 52	76-84	167-183	6	51.3	477	47.7	99.2

Polarization at the end of No. 52 was only 0.16 volt. Measurements of polarization at 70°C. (158°F.) gave 0.15 volt at current densities varying between 13 and 26 amperes per square decimeter (121-242 amp. sq. ft.). It is therefore probable that hot nickel solutions can be operated at high current densities with less anode surface than is at present used for current densities of 10 amperes per square foot.

In experiments with a solution containing 75 grams per liter (10 oz. per gallon) of the "double sulphate" two and a half times the current was required to cause burning at 70°C. (158°F.) that produced this effect in a cold solution, the weight of metal deposited being the same in the two cases. This indicates that concentration of metal is a greater factor in permitting the extremely high current densities used in these hot solutions than is the temperature. The beneficial effect of heating a nickel solution consists in the improved quality of the deposit, and in better anode corrosion. To avoid convection currents the flame by which the solution was heated was removed at the beginning of each test. At the higher current densities there is noticeable heating of the solution by the current.

To make up the bath with nickel chloride proceed as follows: Dissolve the nickel salts in the proper amount of hot water, add nickel carbonate in small amounts at a time and heat until all acid is neutralized; either filter or allow to settle and decant the clear solution and finally add the boric acid.

In so far as anode corrosion is concerned, any soluble chloride might be substituted for the nickel chloride, but not without some effect on the character of the deposit. Magnesium chloride or sodium chloride seems to be preferred for this purpose. In case either of these is used, neutralizing might well be done by the carbonate of the same metal. Ammonium salts and the "double sulphate" of nickel are to be avoided, since they are likely to cause crystallization from the solution when cold.

A nickel solution that is extensively used consists of the single sulphate, boric acid, and common salt. In order to learn if the substitution of common salt for the nickel chloride of the laboratory plating bath would cause any marked difference in its operation the following solution was tested:

	Grams/Liter	Oz./Gallon
Single sulphate	240	32
Sodium chloride	30	4
Boric acid	22	3

TESTS OF BATH WITH SODIUM CHLORIDE.

Exp.	Temperature C°	Temperature F°	Time, Min.	Amperes per Sq. Dm.	Amperes per Sq. Ft.	Ampere-Hours per Sq. Ft.	Cathode Eff. Per cent.	Deposit.
No. 42	32	90	5	19	177	14.7	25.6	Good
No. 43	71	160	5	19.6	184	15.3	82.3	Burned one edge
No. 44	76	169	5	20.8	193	16.1	82.8	Burned one edge
No. 86c	84	183	3	20.2	187	9.3	...	Fine
No. 68d	78	172	4	25.3	234	15.6	...	Burned

Although this solution gave fine results, it is inferior to the bath containing nickel chloride, in not permitting the use of so high a current density.

To obtain the best results from a hot solution the current density must be high; cables and tank rods must therefore be of ample capacity. Control of a hot solution by regulation of the amount of anode surface will probably be easier than in a cold bath. The heating coil should be of heavy lead (or hard lead) pipe, with a settling space of five or six inches below the lowest coil; lead will also serve as a lining for the tank. If an electric cleaner is operated from the plating dynamo, either the heating coil should be electrically insulated, or all rheostats should be connected on the cathode side of the line. Should gas pitting occur on first using the solution in the morning, it may be avoided by heating the bath to boiling for a few minutes before beginning plating. Seventy degrees centigrade (158°F.) is a good temperature at which to operate a hot nickel bath.

Owing to the peculiar properties of electrolytic nickel, the advantages of a hot over a cold solution are greater in nickel plating than in the deposition of any other metal.

ADVANTAGES OF A HOT OVER A COLD NICKEL SOLUTION.

1. Heating from 25° to 70° C. (79° to 158° F.) lessens the resistance of the solution one-half.

2. The current density may be increased two and a half to three fold.

3. The current efficiency, if less than 100 per cent in the cold solution, is raised.

4. Anode corrosion is greatly improved, and higher current densities may be used at the anode as well as at the cathode.

5. The deposit is superior to ordinary nickel plate in toughness and freedom from peeling.

6. In the solution tested, plating may be done at 200 to 300 amperes per square foot (22 to 33 per sq. dm.), at which rate the same amount of metal is deposited in five minutes as requires one and a half hours in the "rapid solutions" now in use at ten amperes per square foot.

PICRATE OF NICKEL.

One of the reasons why the price of nickel has gone up is due to the discovery that it may be used in place of mercury for making caps for rifle bullets and detonators for larger projectiles. The form of nickel used for this purpose is known as picrate of nickel.

If nickel is dissolved in nitric acid, and picric acid be combined with the mixture, the result is picrate of nickel. This substance is a tremendously sensitive and powerful explosive, so dangerous that it could not be handled with safety except by experts. But the same is true of fulminate of mercury. The latter cannot be handled in quantity, but for war purposes is put up in small metal capsules—caps and detonators—for setting off cartridges, bombs, grenades and shells.

THE ANNEALING OF CAST BRASS.*

A Study of the Microstructural Changes That Occur in the Alloy 88 Copper, 10 Tin and 2 Zinc.

By Henry S. Rawdon.†

[As was announced in "The Metal Industry" for December, 1915, this bulletin has now made its appearance and the following extracts will serve to acquaint the casual reader with the intent of the paper. Copies of it may be had by addressing the Bureau of Standards, Washington, D. C.—Ed.]

INTRODUCTION.

Most of the questions which this study attempts to answer arose in connection with the work on the standard specimens of zinc bronze (Cu 88, Sn 10, Zn 2), described in Bureau of Standards Technologic Paper No. 59. The samples were chosen from the series prepared in that investigation.

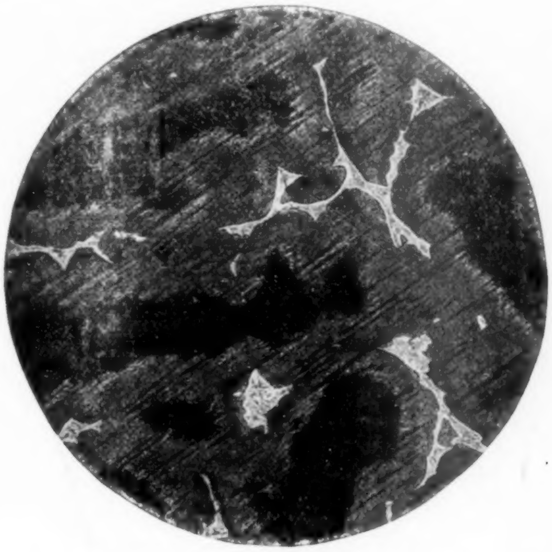
The physical properties of cast bronze are very materially altered by heat treatment, this modification of properties being accompanied by decided changes in the microstructure of the metal. These structural differences are especially marked if the sample has been subjected to mchanical work of any kind previous to the heat treatment (rolling, hammering, etc.). Fig. 1, *a* and *b*, illustrates this change. The structural changes here noted as accompanying the annealing after distortion may be taken as typical of the copper-rich brasses and bronzes, and in general of most alloys in which copper is the predominating constituent.

AIM AND SCOPE OF THE WORK.

The general purpose of the work is to show the stages through which the alloy passes in going from structure *a* (Fig. 1) to that shown by *b* of the same figure, and the conditions necessary for this change. While it is quite widely understood that condition *b* is the result of annealing, following distortion of the original structure, the opinion is by no means general that this is always true. Inasmuch as the common commercial use of annealing, in the application to brass or bronze, is to relieve the internal stresses of material which has been mechanically "cold worked" in some way, the resulting change of structure is often, though erroneously, regarded as an effect of annealing, pure and simple. By some this change of microstructure is seemingly regarded in the same light as the grain refining of steel.

Instances are found in the literature on this subject of the recrystallized state resulting directly from the cast condition upon annealing without the intermediary of the preliminary distortion of structure.[1] One of the main objects of this work is to see if such be true for this bronze—i. e., whether a condition resembling, in the effect produced, a "cold working" of the alloy can be brought about by very unusual methods of cooling. In speaking on this subject Portevin suggests that such may be the case. As the alloy in question is a complex one, ordinarily consisting of two phases in the cast condition and with a transformation of one of the phases involving a volume change, it appears that Portevin's suggestion may be the correct answer to the question. The temperatures at which the different structural changes are completed, together with the period of heating required at these temperatures, are also carefully noted.

No attempt is made to test out any of the various theories as to the exact nature of this process of recrystallization, although the results obtained appear to substantiate materially one of the two main theories on this subject. In short, answers to the following questions were sought: Is distortion of the crystalline structure a necessary condition for recrystallization? Can such distortion be approximated by any unusual methods of cooling? What changes other than "recrystallization" accompany annealing and at what temperatures are they completed?



a, Bronze directly after casting, very slowly cooled. 100×; etching, ammonium hydroxide and hydrogen peroxide.

b, Bronze in the annealed condition after "cold-working." The light and dark parallel bands indicate the twinned crystals. 100×; etching, ferric chloride.

FIG. 1.

STRUCTURE OF THE ALLOY.

1. CAST CONDITION.

The microstructure of the metal upon solidifying after casting is shown in Fig. 1*a*. The metal is composed essentially of a matrix consisting of a solid solu-

* Taken from Technologic Paper, No. 6, issued by the Bureau of Standards, Washington, D. C.
† Assistant Physicist, Bureau of Standards.

[1] Portevin Rev. de Met. 6, p. 713; 1913.

tion, α, of tin in copper (disregarding the zinc, which does not cause any pronounced structural change) in which are embedded inclusions of a eutectoid consisting of this same α solution and another one, δ, which is hard and brittle. The formation of the cored structure of the a matrix which is characteristic of solid solutions, will be made clear by reference to Fig. 2, which shows a portion of the equilibrium diagram of copper and tin.

Upon cooling, the bronze under consideration solidifies gradually through the range of temperature represented. The solidification is a case of selective freezing; that portion separating out first as a solid is richer in copper than the surrounding melt and may be represented in composition, approximately, by the point m'. The process of solidification begins simultaneously throughout the mass of the metal at many points. The subsequent successive additions of solid material to the nuclei thus formed will be lower in copper than the nucleus and may be represented in composition by successive points on the line m to a.

It has been found by observation that it is characteristic of solid solutions of metals for the crystals to grow faster in certain directions than in others during the process of solidification, thus fingers or branched forms result rather than geometrically symmetrical shapes. At 790 deg. C., approximately, the alloy consists of crystals, each of which is an entangled treelike structure with a

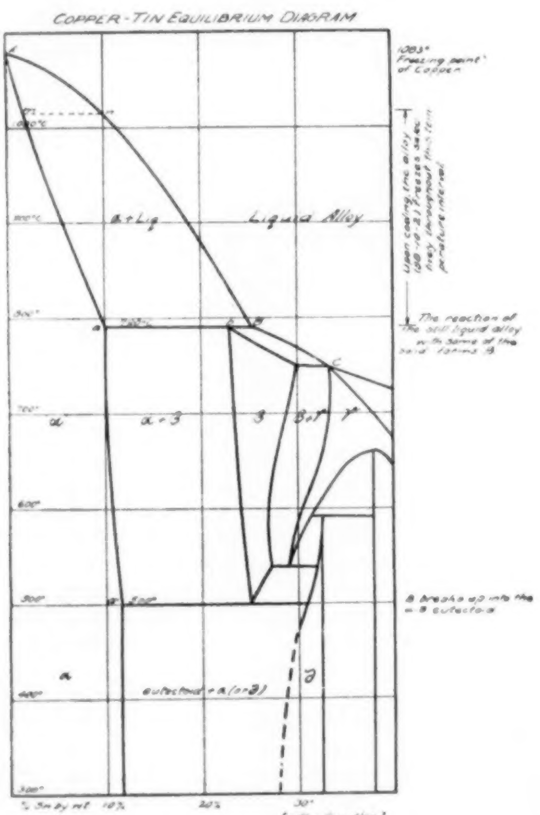


FIG. 2.—A PORTION OF THE EQUILIBRIUM DIAGRAM OF COPPER AND TIN.

liquid portion, rich in tin, filling the crevices between the branches. At 790 deg. this liquid portion (B Fig. 2) reacts chemically with some of the adjacent solid to form a solid solution (b) of copper rich in tin. This second constituent is termed the β solution. On further cooling, this β constituent breaks up into a eutectoid of the α and δ solutions of copper and tin at 500 deg. C. The name "bronzite" has been suggested for this eutectoid. The changes in composition, due to diffusion during cooling, may be disregarded here and in cast alloys in general.

The bronze, then, after casting, consists of grains, or crystals, relatively large in size, i. e., large enough to render them plainly visible to the unaided eye. The size of such crystals will depend upon the rate at which the alloy cooled during the solidification, the freedom from mechanical disturbances, etc. Each grain has a complex structure and consists of a treelike framework of a solid solution of copper and tin, the branches of which are not uniform in composition, but have a core rich in copper. These branches intersect during the growth of the crystal and form a tangled mass with tiny crevices in the angles between the branches which are filled with a second metallographic constituent—a eutectoid comparable to the constituent, pearlite, in steel.

SUMMARY.

1. The metal, upon annealing, is first brought into "physico-chemical equilibrium." The dendritic structure persists until heated for approximately two hours at 800 deg. C. The absorption of the eutectoid depends much on how the cast sample cooled while solidifying; four hours' heating at 800 deg. is required for its disappearance in those samples which solidified very slowly.

2. No evidence was found suggesting a change of crystal size of cast samples which had not been distorted in any way.

3. Recrystallization, including "twinning," was found only to follow distortion or its equivalent; metal cooled suddenly from the molten state behaves similarly because of the high internal stresses resulting. "Chilled" castings may be expected to act in a like manner upon annealing.

4. The progress of recrystallization upon annealing for different periods of time at the same temperature is in agreement with Tammann's theory of recrystallization.

5. Aside from the crystal size and shape and the modification introduced by "twinning," the end condition of material annealed directly after casting and that annealed after a preliminary distortion of the crystalline structure is the same in the two cases.

PREPARATION OF FRENCH SAND.

French molding sand is first treated by being put through a sand grinder, crushing or mixing mill so that all the particles will be reduced to about the same size and then again thorough amalgamation is assured by this process.

All new sand must not be used in order to make successful molds, as the sand must first be burned, that is to say, it must come in contact with molten metal at least three or four times before it is fit for use. After getting the sand in condition by the burning process, it will be found that one-half new molding sand can be mixed with it to make molds; although I would advise that not more than twenty to twenty-five per vent. new sand be added at one time. The object in adding the new molding sand to the old is to increase its bond and is only necessary at long intervals of time. French sand has the best and most durable of natural bonds and is also very tenacious.

In tempering the sand care should be taken to work it as dry as possible, that is to say, with the least possible amount of water.

French sand is not only used on statuary bronze work, but it is also used as a facing by sprinkling it on the pattern through a cotton bag and then backing it up with a coarser sand. There is also a sand known as "Windsor Locks," which is just as good as French sand for facing work, but is not to be compared with the French sand on statuary bronzes.—W. H. P.

THE BRITTLENESS OF ANNEALED COPPER*

A Report of Tests of Various Deoxidizers on Virgin Copper.

By W. S. Ruder.†

In the process of manufacture of commercial copper, it has been found advisable to leave a certain amount of oxygen in the copper in order that it may retain the very desirable properties of ductility and mechanical strength. The ease with which copper takes up oxygen during smelting makes it necessary that this oxide be removed by the process of "poling," during which the oxide is reduced by the gases given off by the green poles. This process is carried on until only the small amount of oxygen necessary to produce "tough pitch" copper remains. This oxygen exists in practically all commercial copper, not specially deoxidized, in the form of Cu_2O and forms a matrix of eutectic around the primary copper grains.

It is common practice in annealing copper to maintain a strictly neutral or slightly oxidizing atmosphere. In the practice of the process of calorizing (Trans. Am. Electrochem. Soc., 27, 253, 1915) it was found that copper articles became quite brittle even at temperatures as low as 500° C. In forging and working copper it is also necessary to have the atmosphere of the heating furnace pretty well regulated, or the whole lot will become unworkable.

Copper rail-bonds made up of strands of commercial copper wire, heated in an oil muffle during the process of manufacture, frequently and irregularly showed brittleness as though burned, but there was no sign of oxidation. It was assumed that the harmful effect was due to reducing gases from the fire which sometimes come into direct contact with the copper. To demonstrate this, an experiment was tried as follows: Two quartz tubes were placed into a vertical electrically-heated furnace. One was closed and the other open at the lower end, while the upper ends of both tubes were open and extended outside the furnace. Commercial copper wires were placed in each of these tubes. Hydrogen gas was fed into the furnace and came into contact with the wires in the open tube, but not with the others. The result of heating to red heat for ten minutes in this case was the apparent rotting of the wire in the tube open at both ends but not in the tube closed to the hydrogen.

Further evidence that this brittleness is due to the action of the reducing gases upon the dissolved oxygen is had from the fact that copper to which boron carbide or some other deoxidizing agent has been added does not show this effect. It is the purpose of this paper to report the result of a few experiments made to determine the effect upon regular and deoxidized copper, at different temperatures, of a few of the more common gases met with in practice.

Cuprous oxide may be reduced by hydrogen or carbon monoxide at temperatures as low as 200° C. Some effect must therefore be expected, even at temperatures below those usually employed in annealing.

In these experiments wires of plain 0.15 in. (3.8 mm.) and boronized 0.125 in. (3.2 mm.) copper were used. It was soon found that smaller wires were more sensitive to exposure for a short time at the lower ranges, and so a piece of 0.05 in. (1.3 mm.) wire of each kind was also used in each run. No accurate measurements of brittleness were made, as a simple bending test was sufficient for our purpose. If a wire would not stand bending to a right angle and back without cracking, it was termed brittle. Samples were run at 100° intervals from 400° C. to 1,000° C. and held for two hours.

*A paper presented at the Twenty-ninth General Meeting of the American Electrochemical Society held in Washington, D. C., April 27-29, 1916.
†Research Laboratory, General Electric Company, Schenectady, N. Y.

EFFECT OF HYDROGEN.

Electrolytic hydrogen, purified by running over hot copper and thoroughly dried over P_2O_5, was used.

COMMERCIAL COPPER.

At 400° C. no brittleness could be detected after a two hours' anneal. After 31 hours' anneal, however, a decided weakening had occurred.

At 500° C. the smaller wires were quite brittle after two hours, and the large one cracked on the surface, showing that the action had started.

At 600°C. the brittleness had penetrated about 3/64 inch (1.2 mm.) on the large piece, and the small wire was extremely brittle.

At 800°C. the large wire became so brittle that it broke on bending through an angle of 10°.

At 1000°C. the copper was still brittle, but showed a marked tendency toward recovery.

On remelting in hydrogen the copper was restored to its original ductility.

DEOXIDIZED COPPER.

Copper, which had been deoxidized by the addition of boron in the form of boron carbide, and run through the same treatment as the regular copper samples above, in no case exhibited the least trace of brittleness.

EFFECT OF WET HYDROGEN.

Hydrogen bubbled through water had the same effect as the purified hydrogen, except that the brittleness did not appear until a temperature of 600°C. was reached. Deoxidized copper was not affected by any temperature.

EFFECT OF CARBON MONOXIDE.

Brittleness was not observed in this treatment until a temperature of about 850 to 900°C was attained. At 900°C. and 1000°C., however, extreme brittleness was caused in two hours. As in previous cases, boronized copper was unaffected. The high temperature needed to produce brittleness in this case was probably due to the presence of considerable CO_2 mixed with the CO. The CO gas was made by passing a slow stream of air over incandescent charcoal. The samples were all somewhat oxidized on the surface.

EFFECT OF CARBON DIOXIDE.

Tank CO_2 dried over sulphuric acid was used in these experiments. The samples scaled quite severely at the higher temperatures, but no perceptible brittleness occurred in any of the samples except the boronized copper run at 900° C. and 1,000° C. This result was rather unexpected, and the reason why this deoxidized copper should be more brittle than the regular copper under these particular circumstances is not yet clear, as oxidation should have made each one brittle.

EFFECT OF STEAM.

A slight brittleness was observed in regular copper at 700°C. This increased with the temperature, but in no case was the material as brittle as that treated in hydrogen or CO gas. An explosion of the hydrogen gas occurred at the mouth of the furnace running at 1,000°C.

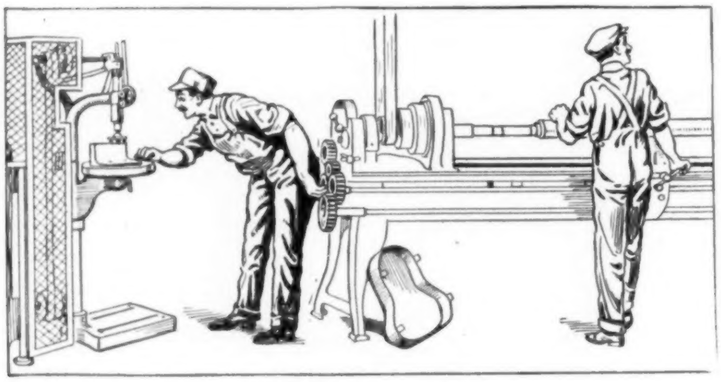
SUMMARY

It has been shown that the brittleness of copper developed during the heating in the process of manufacture and frequently ascribed to "burning," is in reality a deoxidation. With ordinary commercial copper, serious brittleness begins to appear at 400°C. in dry hydrogen,

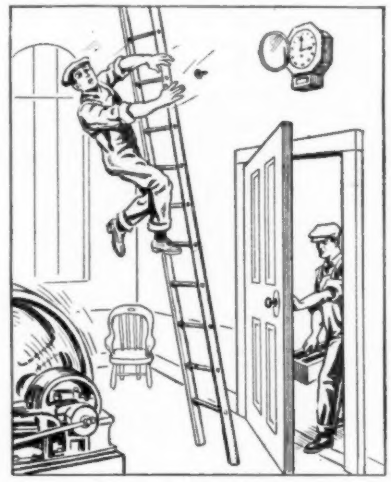
at 600°C. in wet hydrogen, at about 800 to 850°C. in CO, and at 700°C. in steam. Copper which had previously been deoxidized by the addition of boron remains unaffected at all temperatures in a reducing atmosphere. This brittleness is therefore due to the reduction of the cuprous oxide around the primary copper grains, leaving a spongy mass of little mechanical strength, and not to any direct action of the hydrogen upon the copper itself.

THE CARELESS HABIT

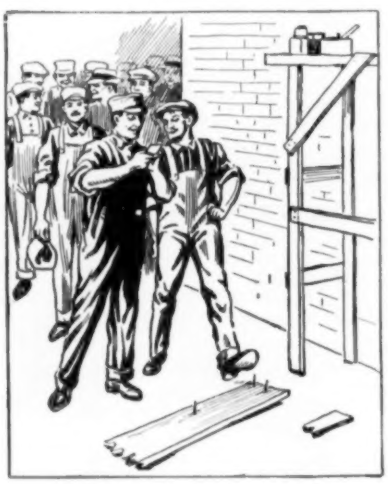
The Most Complete Safeguarding of All Machinery and of All Dangerous Places in and Around Workrooms Can Prevent Only a Very Small Proportion of Industrial Injuries. A Page of Safety-first Hints Put Forth in a Striking Manner, from the April Issue of the "Spirit of Caution," Issued by the National Affiliated Safety Organizations.



Gear guard in wrong place.



Forgot about the door.

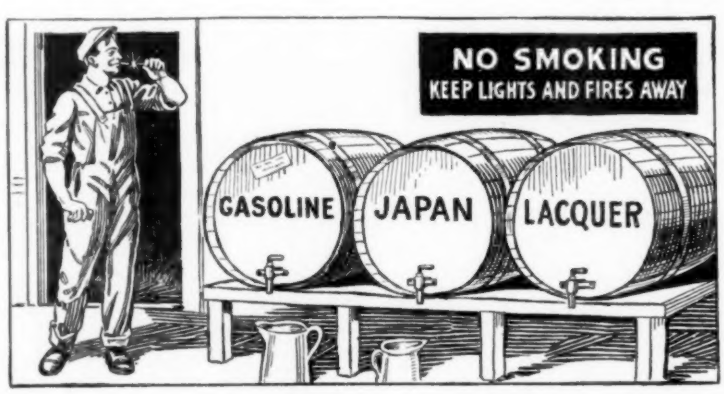


Somebody dropped board, nobody removed it.

What safeguard is available for the man whose sense of responsibility is so meagre as to leave a box on the stairs?

Watching the other fellow's job.

Careless workman leaves obstruction where another may stumble over it.



Promoter of fires and explosions.

EDITORIAL

OLD SERIES
Vol. 22. No. 5

NEW YORK, MAY, 1916.

NEW SERIES
Vol. 14. No. 5

THE METAL INDUSTRY

With Which Are Incorporated
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Published Monthly

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CONTENTS

PHOSPHOR BRONZE IN WAR AND PEACE

As an illustration of the extremely important part the metals are playing in these days of international strife, we have only to point to the controversy now going on between Germany and the United States. The severing of diplomatic relations between the two countries may depend on the identification of a few pieces of metal.

The conclusions of experts based on the evidence collected in the matter of the sinking of both the Turbantia and the Sussex seem to settle conclusively that the several pieces of metal found in various places after the sinkings were phosphor bronze and that they belonged to German torpedoes as no other nation is now using such metal in the manufacture of torpedoes.

The evidence in favor of such a conclusion is overwhelming and does not seem to permit of any possible evasion of the issue by the nation accused of the atrocity. In the appendix to the note sent to Germany by the United States under date of April 18, 1916, we find the following facts bearing on the case:

"The pieces of metal which the American officers had collected were compared by Lieutenant Smith, Lieutenant Commander Sayles and Major Logan with mines and plans of mines in possession of the French naval authorities at Boulogne, Rochefort and Toulon, and British naval authorities at Portsmouth. These officers are positive in their opinion that these pieces of metal were not parts of mines. (Report of Lieutenant Smith, cabled April 2 and 5.)

"Among these fifteen pieces of metal were two screw-bolts showing the effects of an explosion, which were stamped with "K" and "56" on faces of the head of one, and "K" and "58" on faces of the head of the other. On examining German torpedoes in the possession of the French naval authorities at Toulon, and of the English naval authorities at Portsmouth, the American officers found that identical screws with the letter "K" and a number were employed to fasten the "war" head (Kopf) to the air chamber. (Lieutenant Smith's reports, cabled April 2, 5 and 13.)

"The screws used in French and English torpedoes have no markings and are of a slightly different size. (Same reports.) Furthermore, the American officers were able by comparison and close examination to positively identify and locate all the remaining pieces of metal as parts of a German torpedo, as follows:

"Fragment 3, part of inner seat of water relief valve of engine valve.

"Fragments 4 and 5, punto bands of engine room casing.

"Fragments 6 and 10, inclusive, and 12, parts of engine cylinders.

"Fragments 11, 13, 14 and 15, parts of steel warhead still bearing the distinctive red paint common to German torpedo warheads. (Report of Lieutenant Smith, cabled April 5.)

"In view of these authenticated facts there can be no reasonable doubt but that the Sussex was torpedoed and that the torpedo was of German manufacture. As no vessel was seen by any person on the Sussex the conclusion is irresistible that the torpedo was launched without warning from a submarine which was submerged at the time of the attack and remained beneath the surface after the explosion."

In relation to the metal parts found in one of the lifeboats of the Dutch steamer, Turbantia, a notice of which was given in the April issue of THE METAL INDUSTRY, the German government has admitted that the vessel was sunk by a torpedo and has made an offer of reparation in the shape of a North German Lloyd steamer. This admission on the part of Germany it seems to us is tantamount to a confession that the Sussex was also torpedoed, for, as we understand it, the character of the pieces of metal found in each instance was identical.

The use of such an efficient and admirable alloy as phosphor bronze for such a horrible purpose as sinking harmless ships and murdering innocent persons is indirectly in opposition to the prime object of the alloy's introduction. This was safety first, the conservation of human life and not the destruction of it. It is interesting to note that phosphor bronze has always been chosen in engineering work because its factor of safety was high, in other words, because it was found to be a dependable alloy. In railroading, where perhaps more lives are in the balance than in any other form of human endeavor, we find stringent specifications drawn up designed to safeguard to the utmost human life. These specifications are met with ease by phosphor bronze and may properly be included here to give an idea to those not familiar with the alloy of some of its chief characteristics.

SPECIFICATIONS FOR PHOSPHOR BRONZE IN RAILROAD WORK.

Phosphor bronze shall be a homogeneous alloy of copper and tin of crystalline structure. It shall be made from new metals, except that scrap of known composition produced by the foundry at which the bronze is cast may be used. It shall not contain sulphur. The phosphorus shall be introduced in the form of phosphor-tin or phosphor-copper. Castings shall be sound, clean and free from blowholes, porous places, cracks and other defects.

The alloy shall be cast into ingots and allowed to cool, and the castings shall be poured from the remelted ingots. Care shall be exercised that the metal is not overheated and that the temperature at pouring and the conditions of cooling are such as will be most likely to secure dense castings.

The chemical and physical qualities shall be as follows:

	Grade A	Grade B	Grade C	Grade D
Copper per cent	80 about	85 about	80 about	88 about
Tin per cent	20 "	15 "	10 "	10 "
Lead per cent	—	—	10 "	—
Zinc per cent	—	—	—	2 "
Phosphorus per cent	1.0 max.	1.0 max.	1.0 max. 1.7 min.	0.25 max.
Other elements per cent.	0.5 max.	0.5 max.	0.5 max.	0.5 max.

From the above it will be seen that the phosphorus exerts a larger influence than that of a mere deoxidizer. Aside from reducing oxides dissolved in the alloy the phosphorus exerts a very material influence upon its properties. The presence of phosphorus in the alloy is useful in giving the tin a more crystalline character and this enables it to alloy itself more completely and firmly with the copper, thus making a more homogeneous alloy. By increasing the amount of phosphorus to more than that necessary to make the alloy of phosphor tin in the alloy, a portion of the copper also combines with the phosphorus, and the bronze then contains, beside copper and tin, combinations of crystallized copper phosphide with phosphide of tin. The strength and toughness of the bronze does not suffer by a greater addition of phosphorus. But its hardness is considerably increased so that many phosphor bronzes are equal in this respect to the best steel and some even surpass it in general properties.

ELECTRO-PLATERS' CONVENTION

The announcement, published in the ASSOCIATION and SOCIETY columns of this issue of THE METAL INDUSTRY, that the 1916 convention of the American Electroplaters' Society will not be held in Canada, will, we are sure, be received with satisfaction by all concerned. At this time discretion dictates that it is much better to avoid unpleasant complications rather than to have to untangle and smooth them out afterwards. There are so many conflicting influences to be considered if the convention were to be held in Canada that the decision of the Toronto Branch to relinquish their claim to the convention must meet with high praise from the members of the Society. At the same time the Toronto Branch must be given a large amount of sympathy for the evident disappointment experienced in the, for the present, lost opportunity to act as host to the delegates of the other branches.

A loyal spirit is always to be admired, and this evidence of such a quality possessed by the Toronto Branch in relation to the parent body cannot fail to excite respect and esteem. We take this opportunity therefore to congratulate the Toronto Branch for their unselfishness and good sense, extend to them our sympathy for their keen disappointment and offer them consolation that there are other conventions to come. One advantage, if it may be called such, they will have, and that is, that perhaps they will have the record of several conventions before them when their turn does come. Thus they will have an opportunity to surpass all former efforts and make THEIR CONVENTION the best ever.

CORRESPONDENCE AND DISCUSSION

WE CORDIALLY INVITE CRITICISMS OF ARTICLES PUBLISHED IN THE METAL INDUSTRY.

THE 1916 ELECTRO PLATERS' CONVENTION

To the Editor of THE METAL INDUSTRY:

The great European conflict has brought about many changes in conditions in the policies of the nations of the world and how long such conditions will continue to exist is difficult to tell. America with its diverse population has felt the influence of such changes and conditions probably more than any other country in the world with the exception of the nations at war.

Canada with its complex population has also felt such changes in policy and sentiment and one of the changes in conditions that comes very near to many of the readers of THE METAL INDUSTRY and which will no doubt be received with much satisfaction, is the surrender of the fourth annual convention of the American Electro Platers' Society by Toronto Branch. This convention will now be held in Cleveland on July 6, 7 and 8.

In surrendering the convention in compliance with the wishes of a majority of the membership of the society, Toronto Branch has accomplished a laudable act and one that will not be forgotten by the entire membership when conditions in world affairs again become normal. Toronto has a right to expect, and that right will be sustained, that a future convention will be held in the splendid Canadian city. Toronto should not be forgotten in the deliberations of the Supreme Society at the convention for so gracefully surrendering her vested rights with only one purpose in view—to create harmony, goodfellowship and unity in the society; for these are the cardinal principles upon which every institution must stand or fall.

THREE CHEERS FOR TORONTO!

Cleveland is a splendid convention city, with its varied industries and splendid park system. It is situated on Lake Erie within a night's ride by steamer from Buffalo, and members who anticipate taking their wives with them for a visit to Niagara Falls can do so at practically little extra cost.

So all pull together, the Cleveland Branch will do the lion's share and what it expects is the assistance of every branch by sending a goodly representation to the convention. All will no doubt enjoy themselves and be assured of a splendid time.

CHARLES H. PROCTOR.

New York City, May 4, 1916.
Founder American Electro Platers' Society.

BRASS FOUNDRY BOOK LORE.

To the Editor of THE METAL INDUSTRY:

If any foundryman thinks that the technical books now on sale will help him any in the running of a brass foundry I am sincerely sorry for him. If all the material that passes for knowledge of brass founding was compressed into one little volume, it could not be sold on its merits for thirty cents a gross. The amount of uncertainty that such book knowledge creates is very harmful and is only equaled by the nerve displayed by the compilers (never writers) of such works.

In one of the best-known works on the alloying of brass there are three pages given up to a poem entitled "The Song of the Bell," and the author in common with his kind appeared to be overawed at that colossal undertaking. Now, who cares how a bell is cast in this commercial age and who cares whether it is cast at all? The casting of a bell may have been some stunt a hundred years ago, but any brass founder that knows how to pour metal ought to eat the job today, even if given the job of casting one as big as the Moscow article of which we have read and heard so much.

Most of the works written around and never of the brass foundry bear the unmistakable stamp of the botch. How often we come across such information as "Jonesy states in his work on brass founding that so and so is the case," while "McFlip of the Bureau of Mines states quite the reverse." Now just think of paying good money to be handed such material as the above, and yet I do not in the least exaggerate. There is not one book on the art of brass founding worth shelf space and as to cluttering up your inside pocket with any such work it would be much better to fill the space with a copy of the "Police Gazette." There are some very good books in print relating to iron foundry practice, such as Palmer's, Bolland's and West's works, but not one founder has had the courage to delve into his subject deep enough to produce a first-class book of reference for brass founders.

The reader may ask, Well, what kind of a book would cover the field? Such a work that would be of practical value should contain information relating to the mining, smelting and refining of metals; how they are alloyed and melted and the different makes of furnaces on the market, and data on how to run the furnaces in order to get the best results; also proper methods for making sound copper castings and sound castings of any other single metal and in combination; the difference between iron founding and that of brass, and there is a big difference. The book should also contain information on molding, core sands, proper method and rules for gateing patterns, mounting patterns on molding machine plates, core ovens, core-making machines and molding machines of all makes and designs and the principles by which they work, also their limitations. Some flask data and what can and cannot be made in a snap flask sould also be included, parting compounds and the like, how to avoid the making of "scabby" castings and all other necessary information that a brass founder requires.

The "Brass Moulder Illustrated" is an English publication. and its author, Alex. Purves, confesses to having traveled very extensively throughout Scotland and England gathering material for this work and suffering untold agonies while doing so.

Unlike many other technical books, its title is not misleading in that it tells the truth while attempting to convey to the young mind a knowledge of molding pure and simple. Also it does not stray far afield on matters not in the least related to the subject at hand. There are many examples of trick molding described, and while it is knowledge that is always valuable for a molder to know, a great deal of the space given up to this class of molding could have been devoted to a better cause, which in plain English means a knowledge of how to get work out fast and good.

In this age of rapid production it is conceded by everybody conversant with foundry conditions that it is not the molder that produces the work nowadays, but the patternmaker and the molding machine. Then why not write books on how best to turn out a glorious day's work and not waste a lot of time describing how to do false core work or how to make a mold without a pattern.

When a man writes a book on brass molding it is assumed that he knows what he is writing about, and if he does not know, then he has no business to try. Again, when a book is published on the subject in 1915 we expect that it will be the last word on brass molding, but if anybody expects that little thing in Purves' work, he is going to be disappointed.

W. H. PARRY,
Superintendent, National Meter Company.

Brooklyn, N. Y., April 29, 1916.

SHOP PROBLEMS

IN THIS DEPARTMENT WE ANSWER QUESTIONS RELATING TO SHOP PRACTICE.

ASSOCIATE EDITORS: JESSE L. JONES, Metallurgical PETER W. BLAIR, Mechanical CHARLES H. PROCTOR, Plating-Chemical

ANNEALING

Q.—I find difficulty in annealing cold rolled steel sheet, gauge 18, 21 and 22. I heat it to a cherry red, but it breaks in the drawing. Will you kindly inform me at what degree of heat I should operate my furnace for cold rolled steel, and how long it should be left in the furnace.

A.—Cold rolled steel is made of varying analyses, depending upon the purpose for which it is to be used. Where the material is to be machined at a rapid rate, or where it is found that sheets stick together in pack rolling, phosphorous is added to the steel by the use of ferro-phosphorous or a very high sulphur content is sought.

Naturally you would not expect high sulphur or high phosphorous steel to draw well, however carefully it might be annealed. You should have an analysis made of your steel and if the sulphur and phosphorous are high replace it with low sulphur, low phosphorous, deep drawing sheet steel.

To anneal your steel heat to 850 degrees Centigrade for one hour, then lower the heat to 720 degrees and hold at that temperature for 12 to 15 hours. Annealing of sheet steel is usually accomplished away from the air, in cast steel annealing boxes. —J. L. J. Problem 2,290.

BRAZING

Q.—Can you inform me as to a remedy or way of preventing borax from "creeping" over castings in brazing brass castings? I have heard of a mixture of graphite, but I never had success in making it adhere. Perhaps I did not make the proper mixture.

A.—If a very sticky (or fat) clay is mixed up with water to the consistency of a thin paint and the brass castings coated with it, the coating when dry will adhere quite well. If the borax flux is used dry, this clay wash will prevent its creeping to a considerable extent and will make its removal easy.

Very often more borax is used for a job than is really necessary. If it is used as powdered borax glass and the brazing solder is fine, there will be little excess of flux to remove.—J. L. J. Problem 2,291.

CLEANING

Q.—What is the best way to remove enamel from auto fenders? The price of potash for removing enamel makes the use of that material prohibitive at the present time.

A.—If the enamel is not baked on the auto fenders at too high a temperature, it may be removed by immersing in a hot bath of heavy naphtha. This material is much cheaper and more satisfactory than potash for removing enamels and varnishes.—J. L. J. Problem 2,292.

DRILLING

Q.—I wish to obtain full information as to the best way to drill ¼ and ⅜-inch holes through a tank of vitrious china which is ⅝ of an inch thick. The holes are to be 1¼ inches from the top of the tank. What is the best drill to use to avoid cracking?

A.—Probably the best plan to adopt is to use a regular glass worker's drill and solution, if you have many holes to drill. These drills are especially tempered and can be obtained from a leading hardware store or jobbers. The liquid used for a lubricant can be obtained at either of the above-mentioned places. However, if you have trouble in getting the liquid, kerosene oil will give good results.

In blocking up the tanks care must be exercised to prevent any strain outside of the space around the hole, and in drilling care must be taken to run steadily and not overheat the drill. A flat forged drill is usually preferred to the round twist drill, if a special drill used for glassware cannot be obtained.—P. W. B. Problem 2,293.

Q.—Kindly inform me of the best process for etching brass signs, whether I should use asphaltum or lead foil. What strength of acid to use and also the kind of enamel for filling the letters and how to apply it so that it will stay.

A.—Asphaltum varnish, as well as the lead foil method, is used extensively as a stop-off in the etching process. Many etchers find that the regular thick black printer's ink answers the purpose very satisfactorily. The use of such methods can be determined better by the etcher himself; some prefer one method while some prefer the other. The asphaltum method is a sure one, having been used for years, and is probably the most used method at the present time. The strength of the nitric acid may vary considerably depending upon the nature of brass alloy and its hardness. One part acid to three to five parts water gives good results. The best signs are filled in with sealing wax. This gives the hardest and most durable filling for letters. The method pursued is to heat the sign to the melting temperature of the wax or slightly higher and then fill in with the wax, which under a sufficient temperature becomes fluid and sets more uniform. The excess of wax is afterwards removed and the signs polished down to an even surface. Soft enamels are also used for the purpose, but they do not offer the resistance to wear that the sealing wax does.—C. H. P. Problem 2,299.

FINISHING

Q.—Would you kindly oblige me with a formula for a solution to electro-plate brass a gray color and also what anodes to use. It would not matter much if the articles had to be copper-plated first, but if it could be done directly on brass it would be less work.

A.—A deposit of arsenic or antimony will give you a gray color. The surface of the brass requires only an acid-dipped finish, but it would be advisable to coat the brass with a thin deposit of nickel before immersing in the arsenic or antimony solution, although this preliminary deposit of nickel is not absolutely necessary.

ANTIMONY SOLUTION.

Hydrochloric acid (commercial)	3 quarts
Water	1 quart
Butter antimony	2 to 4 ounces

Temperature 160 degrees and use anodes of metallic antimony or nickel.

ARSENIC SOLUTION.

Hydrochloric acid	3 quarts
Water	1 quart
Arsenious acid (white arsenic in powder.)	6 ounces

Dissolve the arsenic in the acid by the aid of heat, then add the water. This solution may be used cold or at a temperature of 120 to 140 degrees. A current of 5 amperes per square foot of surface at 2 volts gives the best results in the deposition of arsenic or antimony.—C. H. P. Problem 2,295.

HARDENING

Q.—We have been using, for a great many years, a lead pot in which we dipped our pocket knife blades, file blades, etc., in the process of hardening. We use this lead at a temperature of around 1,400 degrees Fahrenheit, but it has its handicaps, inasmuch as it sometimes adheres to the metal. We understand that there is a material being used which, when cooled, has a whitish cast, similar to alum or mica, and that this substance, while it has all the good properties of the lead bath, does not adhere at all to the file teeth on the file blades. Do you know what this material is?

A.—A great many makers of fine steel tools use the barium chloride bath in preference to the lead bath for tempering. It is no doubt the material to which you refer. A commercial grade of barium chloride is used and before it is melted, about 2 per cent. of soda ash is mixed with it to prevent chloride fumes. Barium chloride costs about 3 cents per pound and it melts at 1,635 degrees Fahrenheit, which is somewhat higher than the temperature that you speak of using. A thin film of the barium chloride adheres to the articles withdrawn from the bath and keeps the air away from them. After quenching in oil this film may be removed by a scratch brush or by putting in hot water. —J. L. J. Problem 2,296.

MIXING

Q.—What is considered a standard mixture for brass steam fittings and how is the red surface obtained without the use of a pickling solution? If pickling is necessary what solution is used?

A.—The standard mixture for brass steam fittings such as valves and cocks is 85 copper, 5 zinc and 5 lead. For ells and tees a cheaper grade is used such as 84 copper, 10 zinc, 3 tin and 3 lead.

The red color surface is obtained by dipping the castings in water from three to five minutes after pouring. This will give a very nice color and what is known as steam metal color and makes the castings appear as if they were made from new metal. However, this color can be obtained by careful handling and the use of scrap metal.

The color obtained from pickling is by cleaning the castings either by sand-blasting or tumbling, the sand-blasting being preferred. Then they are dipped in hydrofluoric acid, then water, then in sulphuric acid, then cold water, then hot water and dry in sawdust.—W. J. R. Problem 2,297.

MOLDING

Q.—Will you kindly advise me if carbon molds are being used successfully by foundries for casting brass?

A.—Carbon molds are being used commercially by a large manufacturing concern. Patents for the process are pending and no doubt details will soon be available. We understand that the molds are permanent, but a sand cope is rammed up each time and very large castings are produced in gun bronze, aluminum bronze, brass, etc. It would probably be possible to obtain manufacturing rights under this new process.—J. L. J. Problem 2,298.

PLATING.

Q.—How do you copper plate galvanized sheet iron and nickel plate it without its showing streaked?

A.—Galvanized sheet iron can be readily plated in a good cyanide of copper bath, if the surface is to be unfinished. Scratch brushing with a steel scratch brush will brighten the surface.

The nickel plating should be done in a special solution consisting of chloride of nickel and sal ammoniac in order to prevent streaking, which usually develops in the regular double sulphate bath.—C. H. P. Problem 2,299.

Q.—We have some long brass tubes for nickel plating, so of course they are done bright. After they have been in the vat for about a half hour a dead film forms on the top, leaving sides and underneath bright. We have tested for acid, tried high and low voltage, filtered and also made up solution strong without success.

A.—The difficulty experienced is probably due to poor conductivity of the bath, or the hydrogen becomes condensed upon the surface, causing a dull gray or burnt-like appearance. As we do not know the composition of the solution in question, we can only suggest as a remedy for your trouble the addition of one or two ounces of magnesium sulphate, that is, epsom salts, per gallon of solution to increase the conductivity. This material is probably the material used for the purpose denoted in the salts composition.—C. H. P. Problem 2,300.

Q.—We are having some trouble in the way of potassium cyanide working out around the seam of door knobs after plating. Can you suggest something that would prevent this?

A.—Of course you realize that if the seam is not perfectly tight and impervious to water it naturally expands when placed in the hot potash bath for cleaning. According to the law of expansion and contraction of metals this applies not only to the potash bath but to other solutions as well and the seam becomes filled up.

Now the only way to remove the solution is by the same method of expansion and contraction, so we would suggest that the articles instead of being washed only once, and that very quickly, be washed several times from cold to boiling water and vice versa. In this manner the solution will become sufficiently diluted and forced out. It might be advisable to slightly acidulate your boiling water. This may be accomplished by the aid of a small amount of sulphuric or acetic acid or cream of tartar.

We suggest also that the knobs be thoroughly dried after washing, in a heater at a temperature of 250 degs. F.—C. H. P. Problem 2,301.

Q.—Kindly advise what sort of a dynamo must we have to operate the following solutions:

1 Cyanide copper solution	200 gallons
1 Acid copper solution	350 "
1 Brass solution	100 "
1 Zinc solution	25 "
1 Nickel solution	250 "
1 Nickel solution	350 "
1 Electric cleaner	350 "

Also the size of the rheostats necessary for the above solutions and the size of the main rods.

A.—To produce sufficient energy to run the solutions specified a dynamo of 4 to 6 volts and not less than a thousand amperes capacity would be required.

Rheostats should be used as follows: 200 gallon cyanide copper solution, 200 amperes; 350 gallon acid copper solution, 300 amperes; 100 gallon brass solution, 150 amperes; 25 gallon zinc solution, 50 amperes, and for the 250 gallon nickel solution 200 amperes, and 300 amperes for the 350 gallon nickel solution. For the electric cleaning solution 300 amperes or more. The rheostat should always be in excess of the required ampere carrying capacity of the solution. Of course, this largely depends also upon the amount of work being plated at one time, the more surface to be plated the more amperes required; so in purchasing rheostats it is well to purchase ampere capacity larger than that actually required.

The main conducting rods in order to have sufficient carrying capacity for redistribution to the various tanks should be 1¼ inches to 1½ inches in diameter and made of copper. Brass is sometimes used, but it gives a greater resistance to the current.—C. H. P. Problem 2,302.

REFINING

Q.—We have a quantity of tin which has a trace of zinc in it. Do you know of any method whereby the zinc can be removed and thus leave the tin pure?

A.—Tin is refined by liquation. The impure tin is charged into a furnace of the reverberatory type and the heat is regulated so as to be only a little above the melting point of pure tin. The liquated tin is run into a kettle heated by a separate fire and is further refined by plunging sticks of green wood into it. The impurities are often removed by "flapping" the tin with iron paddles or pouring it from a height of several feet back into the kettle.

If the only impurity in your tin is a small amount of zinc it would be advisable to use it in brass, as the cost of refining it would be quite a little.—J. L. J. Problem 2,303.

SPOTTING

Q.—What is a copper spot and how can it be avoided? We make car journal bearings and the railroad inspectors are throwing out a number of them because they fracture with a discolored portion which they call "copper spots." We want to know how to avoid the formation of this copper spot, and would also like to know what causes same.

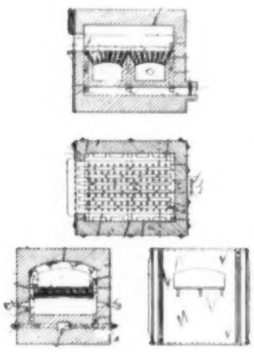
A.—The trouble you mention is due to antimony. The antimony can be removed by oxidation, but the loss in doing this will be high. You will probably find it advantageous to buy ingot metal from some reliable smelting firm who can guarantee their metal to be clean and free from dross and antimony. Breaking the ingots and inspecting the fracture will often disclose faulty metal.—J. L. J. Problem 2,304.

PATENTS

A REVIEW OF CURRENT PATENTS OF INTEREST.

1,177,058. March 28, 1916. **Furnace.** W. S. Rockwell, New York, assigns to W. S. Rockwell Company, New York.

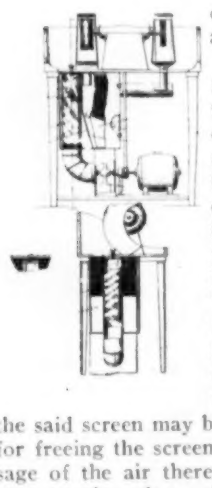
This invention relates to that class of furnaces employed in heating objects of any desired character, as in the operations of annealing, hardening, coloring, tempering, reheating, forging, etc., and the improvements consist in the construction hereinafter described and claimed. In such furnaces, the charge of material or articles to be treated is placed upon the working floor of a chamber in which the heat is applied to the objects, and which the heat is applied to the objects, and which will be called the "heating-chamber" herein. Such heating-chamber receives the heated gases from a chamber in which solid, liquid or gaseous fuel is burned, and this latter chamber is termed the "combustion-chamber," as shown in cut herein.



The passages for the entrance of the heated gases, and the escape of the waste gases, are located at the side of the heating-chamber; and an additional advantage is secured by forming a ledge at one or each side of the heating-chamber, through the top of which such passages are extended, as such ledges provide a space at the edge or edges of the working-floor for the circulation of the heated gases at the side or sides of the charge.

1,177,342. March 28, 1916. **Dust Collector for Polishing Machines.** G. W. and W. H. Leiman, of Newark, N. J.

This invention consists in a polishing machine having novel means, as shown in cut, for collecting the dust rising from the operation of the machine, said means including a hood inclosing the polishing or buffing wheel on the head spindle, an exhaust fan connected to the hood, and a dust collecting box interposed between the hood and fan.



In operation, as the dust is drawn down from the hoods, through the passages, into the entrance chamber, by the operation of the fan, the screen will prevent the passage of the coarser particles of dust into the chamber. The suction of the air will cause a partial vacuum to be maintained in the chamber. This will cause the coarser particles of dust to pass from the chamber, down into the dust settling chamber. The finer particles of dust will be prevented from passing into the tubular screen. These finer particles of dust will drop down into the bottom of the chamber. From time to time, to prevent the screen from clogging, the said screen may be agitated by manipulation of a push button for freeing the screen from dust, and thus permit the ready passage of the air therethrough. The dust may be removed from time to time from the chamber by opening the outside door, and from the chamber by opening the outside door and the inside door.

1,177,803. April 4, 1916. **Coated Metal Button or Similar Article and Method of Making Same.** J. F. Quinn, Providence, R. I.

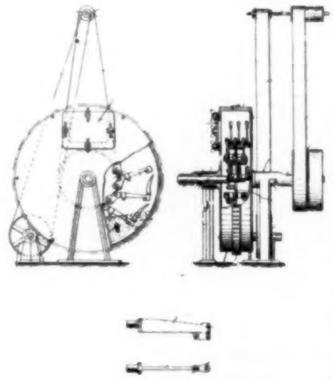
This invention relates to the production of a coated metal button, which shall resemble a pearl button, but which will be much more cheaply made, and comprises both the button, or other similar metal article and the method of producing the same.

Throughout the specification, the term "button" is intended to include other similar articles, whether made in the shape of a button or other similar device.

In practice the inventor dips the button blanks, which are preferably made of brass, or similar metal, more electro-positive than silver, into a so-called silver solution, which comprises, for example, 2 parts of silver chlorid, 6 parts of potassium carbonate, 2 parts of whiting and 3 parts of sodium chlorid, together with a sufficient amount of water, to form a thin liquid. In place of this particular silver solution, any other solution which will electro-plate silver upon the metal button may be used. The metal button after being allowed to remain in the bath for a short time, say 10 or 20 minutes, is removed from the bath and dried. The button, coated with silver, may then be dipped, if desired, into a transparent or semi-transparent cement. Such cement may, if desired, be prepared by rubbing together in a mortar 2 parts of calcium nitrate, 25 parts of water and 20 parts of powdered gum arabic. The button is then dried.

1,178,827. April 11, 1916. **Apparatus for Polishing Metal Bodies.** H. W. Spellman, New Britain, Conn.

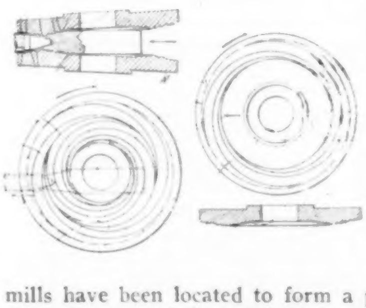
This invention relates to a new apparatus for polishing metal bodies, being particularly adapted for polishing the surface of cutlery and other steel bodies.



At the present time, and prior to this invention, in producing a highly finished surface upon metallic articles, and especially upon cutlery, crocus has been employed to produce what is known as a "crocus finish," the article being subjected to the action of a wheel treated with crocus. The preparation of the wheel requires much skill and patience, and is at the best extremely slow, as is also the polishing operation, and the obtaining of a crocus finish upon articles is therefore very expensive. The object of this invention is to produce an apparatus, as shown in cut, whereby little skill is required and the crocus finish may be imparted to articles in a comparatively inexpensive manner.

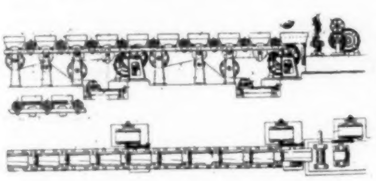
1,177,397. March 28, 1916. **Treatment of Production of Seamless Metal Tubes or Billets.** Wm. Dicks, Dumbarton, Scotland.

This invention relates to the treatment or production of seamless metal tubes, as shown in cut, from solid billets or from hollow billets, and also to the treatment or production of rods from billets. The invention refers to that class of apparatus wherein the working surfaces of disks, rolls or the like, which act upon the billet or work, are provided with one or more series of spirally arranged grooves and ridges which act upon the surface metal of the workpiece and feed it or move it relatively to the remaining portion of the metal of the workpiece. Hitherto such disks or rolls of such mills have been located to form a pass converging in the direction of travel of the workpiece, and these mills have been used



for the production, or reduction of a tube from a hollow billet, by reducing the thickness of the walls of the workpiece, with or without a reduction in the diameter of the workpiece, and the spiral grooves and ridges have acted to feed back or retard the flow of the surface metal of the workpiece. Now, according to the present invention, the reducing or acting surfaces, each comprising grooves and ridges are so disposed on the working faces forming the walls of a diverging pass that when the rolling device rotates they act to accelerate the feed or flow of the outer or surface metal of the portion of the workpiece under treatment.

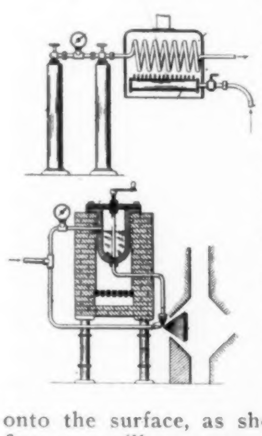
1,179,510. April 18, 1916. **Conveyer for Rolling Mills.** Victor E. Edwards, of Worcester, Mass., assignor to Morgan Construction Company, of Worcester, Mass., a corporation of Massachusetts.



The present invention relates to a conveyer for metal bars, as shown in cut, designed to be employed in connection with a metal rolling mill, and preferably with a metal cutting shear.

The objects of the invention are to simplify and render more compact the driving mechanism of the conveyer, and also to secure an overlapping or shingling effect of the metal bars as they are fed upon and transferred by the conveyer. This conveyer is designed to transfer the metal bars to the ordinary piling rolls by which the bars are piled preparatory to removal. In order to accomplish an even and balanced pile slower speed of the piling rolls than of the remainder of the rolling mill is necessary. And this overlapping or shingling effect of the metal bars is designed to reduce sufficiently the speed of the metal bars as they are delivered from the mill to allow of their convenient handling by the piling rolls.

1,179,762. April 18, 1916. **Metallic Coating and Process of Making Same.** Max Ulrich Schoop, of Hongg, near Zurich, Switzerland, assignor, by Mesne assignments, to Metals Coating Company of America, of Boston, Mass., a corporation of Massachusetts.



The fundamental idea of the invention consists in that the metal is applied to the surface treated as a base in a finely divided molten or plastic condition, and to this end is sprayed, projected or blown onto the surface by means of a suitable agent capable of exerting the required pressure, or of atomizing the metal. This agent may be either high pressure steam, hot compressed air, or any other gas or vapor under sufficient pressure to atomize the metal in a suitable atomizer, whether heated or not.

Instead of atomizing the metal, the liquid metal may be projected onto the surface, as shown in cut, to be coated in a very fine or capillary stream, or a number of streams united to form a spray, there being used for the purpose one or more nozzles of suitable form through which the molten metal is forced. In some cases a continuous fine stream of metal has been forced from a nozzle and broken the continuity of the stream by rapidly vibrating the nozzle, or a stream of metal may be directed against an inclined plate and thus sprayed.

1,178,863. April 11, 1916. **Method for Producing Bands of Aluminum.** E. R. Lauber and R. V. Neher, Emmishoffen, Switzerland.

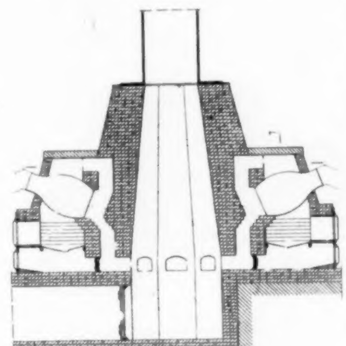
Methods have been proposed by which small sheets or foils of aluminum of 0.0003-inch in thickness can be produced, but strips or bands of aluminum could only be rolled at a minimum thickness of 0.0008-inch, and only a yard or two in length. Bands of a less thickness heretofore have become plaited or torn during the rolling process so that they could not be rolled to lengths desired by the trade.

According to this invention, aluminum, after being annealed by heating to 270° to 320° C. and then allowed to cool, is drawn by rolls at a high tensile strain, and under a comparatively small pressure. Accordingly bands of aluminum of a thickness less than 0.0008-inch, as for instance 0.0003-inch, can be produced, which becomes neither plaited nor torn, and may be produced a mile, more or less, in length.

When producing only one band according to this method, a thick band or strip of aluminum, after having been heated to 270° to 320° degrees C. to anneal the same is wound onto a roll, and the band passed between two rolls driven in opposite directions and at a small pressure, the band becoming elongated thereby. The strip is consequently subjected simultaneously to a rolling and drawing action.

1,180,118. April 18, 1916. **Furnace for the Distillation of Metals.** R. H. Erigle, Trenton, N. J.

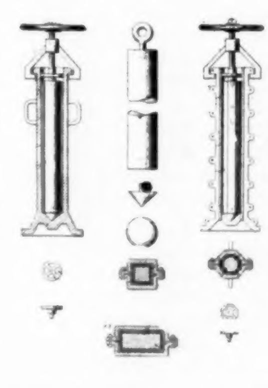
The patent covers the combination in a distillation furnace of a stack chamber, a fireplace at one side thereof, said fireplace having a backwardly inclined front wall, a back flue communicating at the top with the combustion chamber of said fireplace, and at the bottom with said stack chamber, and a retort mounted in said fireplace, and at the bottom with said stack chamber, and a retort mounted in said fireplace so as to extend across the combustion chamber thereof, the inner end of said retort being exposed to the products of combustion descending said back flue, and the neck of the retort projecting through the backwardly inclined front wall of the fireplace.



The combination, in a distillation furnace of a central stack structure, as shown in cut, with chamber therein, a series of fireplaces grouped around said stack structure, a series of descending flues each communicating at the top with the combustion chamber of one of the fireplaces and at the bottom with the stack chamber, and retorts mounted in said fireplaces so as to extend across the combustion chambers thereof, each of said retorts being exposed at its inner end to its respective descending flue.

1,180,249. April 18, 1916. **Compound Metal Body.** Otto H. de Laporterie, New Brighton, Pa.

The fundamental discovery upon which the process rests is that while, unlike metals and alloys of high melting temperatures, such as copper, silver, gold, aluminum, cupriferous alloys (such as bronze, brass, etc.), aluminum alloys (such as aluminum bronze, manganese bronze etc.), do not unite readily under the usual conditions of melting, and volatilize metals of low melting temperature if cast there against at the ordinary casting temperature of such high melting metals; yet, if certain deoxidized and deoxidizing alloys of such high melting metals as above referred to are maintained at a temperature considerably below that at which they are usually cast, and the metals to be coated are previously coated with a metal or alloy of low melting temperature, detrimental oxidation, volatilization, and vaporization are avoided, and the use of protecting apparatuses and added protecting manufactured influences for the film coatings obtained are eliminated. The union secured is absolutely permanent, being inseparable by change of temperature such as heating to red heat and plunging into ice water.



EQUIPMENT

NEW AND USEFUL DEVICES, MACHINERY AND SUPPLIES OF INTEREST.

MODEL HI-LIFT ELEVATING TRUCK

The truck shown in the cut has recently been placed on the market by the Lewis-Shepard Company, of Boston, Mass., and it has a number of very important advantages over existing types claimed for it by the maker. The truck in the first place lifts 2½ to 3 inches, according to the size of the truck, and this, it is claimed, is necessary in an elevating truck so that the wooden platforms will be raised sufficiently to run about over different floor conditions, up and down inclines, and so forth.

Another important factor mentioned relating to this truck is that it will raise and lower its load vertically, which allows loaded platforms to be placed close against each other without

THE HI-LIFT ELEVATING TRUCK.

loss of floor space. As will be seen by referring to the photograph, the third important feature of this truck is that it is made heavy enough to stand rough usage. The elevating truck weighs from 305 pounds upwards, according to size, and as the capacity of all parts have been figured carefully, a margin of safety has been set that will insure long service. Another feature about the truck which the manufacturers lay stress upon is that the load can be lowered without shock or jar, and equally important is the fact that the release check is in a vertical position, so there is no danger of the liquid leaking out, and the check becoming ineffective. Furthermore, the L-S-Co. truck handle is always free of the release mechanism. There is no possibility of the handle flying up and injuring the operator.

CRUCIBLES

The Joseph Dixon Crucible Company, of Jersey City, have issued the following thoughts about crucibles:

The life of the crucible maker is not the halcyon, carefree existence that "foundry folk" possibly have in mind that it is. Leastways it has not been such for many, many weary months, which have been mostly dark nights. The proper clays and the securing of such in sufficient quantities is what has troubled the crucible maker. This, in fact, is "the crucial rock" upon which all their hopes and efforts have been wrecked. But at last the sky is clearing. Clays of more satisfactory sorts have been secured and with their use better results in the foundry will be had and longer lived crucibles will result. It rests, however, with the user, in a measure, to improve the present unfortunate state of affairs, and this can be done in the following ways:

Greater care must be given in annealing—more time must be consumed, after the crucible is received, before it is put into service, and smaller crucibles used than those which the foundry has been in the habit of using. In past years all brass rolling mills, crucible steel casters and jobbing shops thought nothing of having six months or a year's stock of crucibles ahead of their wants—seasoning and drying. Today no sooner is a crucible received than it is put into active service.

The native clays now used by the crucible maker have made the crucible more frail and tender than were those made from foreign clays—more likely to crack on sudden heating and cooling. Therefore, more than ordinary care must be used by the melters in the handling of American clay made crucibles.

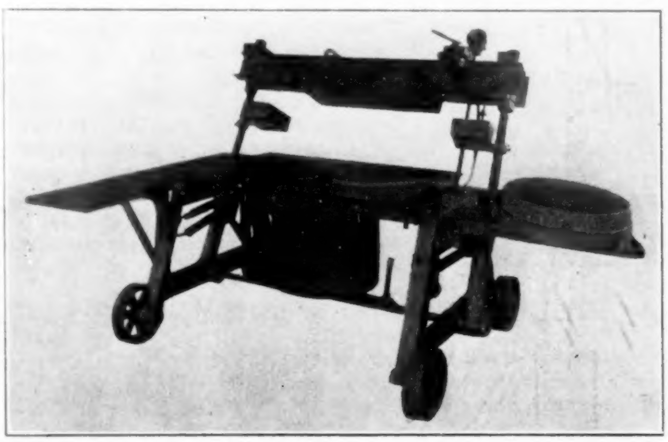
Crucibles should not be cooled down too rapidly, any more than should the heating up be done too quickly. It is a good plan to return the crucible while it is still hot, after the day's work is done, to the furnace from which, of course, the coal has been dumped. By doing this the strain in the cooling will not be as severe and the crucible will not crack so early in its life.

The smaller the crucible is the greater are the number of heats that can be secured. Therefore, if a crucible of a size or two smaller than what is generally used is adapted, better values and less disappointments will be the results. For instance, if a foundry uses a No. 400 pot, let them adapt a No. 300 or a No. 225; or in a shop where No. 60's are the rule, let it be a No. 45 or a No. 50. In this way both caster and crucible maker will be relieved of the hundreds of annoyances and complaints that for the last few months have made their bed—one of roses, with the petals, buds and flowers all plucked off.

PNEUMATIC POWER SQUEEZER

The power squeezer or molding machine shown in the cut is an improved type, which has just been put upon the market. The machine of the size shown, 16 by 48 inches, is the largest standard size that is built by the manufacturer, J. F. Webb Manufacturing & Supply Company, Davenport, Iowa.

The machine, it is said, can be used to good advantage with a snap flask as well as with a larger flask. Among the improvements claimed for this machine over other types may be mentioned the operating valve, which is guaranteed to be air tight. The manufacturers state that they know of one instance where



A PNEUMATIC POWER SQUEEZER WITH 16" CYLINDER AND 48" SPACE BETWEEN SIDE RODS.

this valve has been in service for ten years and shows no leak. Either type of vibrator can be furnished with the squeezer. A pattern plate type is shown on the table in the photograph, but a vibrator can be attached direct to the machine, both types being operated by a knee valve.

The regulating valve shown under the table of the machine to the right regulates the ramming of the sand, and can be changed to get any desired pressure. When the required pressure is obtained this valve remains at this pressure so that the operator knows that all molds will be rammed uniformly. The machine fully equipped includes a side shelf, a riddle rack, a blow valve, regulating valve, air gauge, two tool boxes, and also a vibrator of either type.

I-RITE

THE I-RITE PYROMETER.

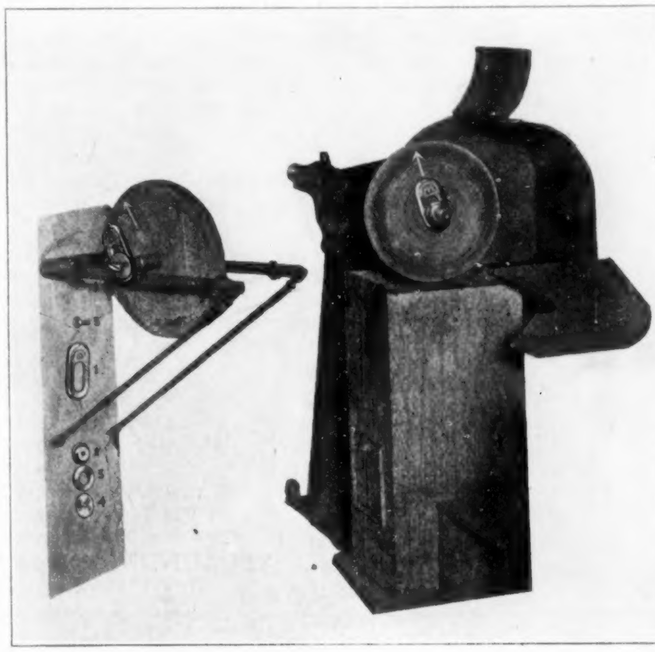
The pyrometer shown in the cut is manufactured by the Gibb Instrument Company, of Pittsburgh, Pa., and is one that operates on the radiation principle, that is, it duplicates the color of heated bodies, and at the same time indicates the temperature on an accurately calibrated scale. The manufacturer of the pyrometer claims that it is possible to read temperatures of the piece of metal under treatment within one or two per cent. of the real temperature, regardless of the furnace temperature.

The pyrometer, which is known by the name of I-Rite, is claimed to be manufactured in such a manner, and is so simple, that it can be safely placed in the hands of the unskilled workman, and the construction is such that it cannot get out of order. It can be used for taking the temperature of a heated body either within or without a furnace. The pyrometer is made in two ranges from 1,000 to 1,800 and 1,800 to 2,300 degrees Fahr.

THE I-RITE PYROMETER IN USE.

SAFETY WHEEL BALANCING WASHER

The balancing washer shown in the cut does away with the dangerous practice of nailing lead on the wheels, which is liable to fly off and put the operator's eye out. This washer is made of malleable iron and is perfectly safe, and saves the lathe, glue and emery, and will save time enough in a half day to each operator to pay for itself. A man can balance a wheel in one minute with this washer, while it takes, sometimes, as much as one half hour to balance a wheel with lead, and then it isn't in perfect balance. A man can balance ten wheels on an average with a washer to one with lead, and they always run true if the wheel fits the spindle; if not, it should be bushed so it will fit, then the wheel can be turned down true. A man can balance all the wheels he wants to use for a half day all at once and



THE SAFETY WHEEL BALANCING WASHER IN USE.

mark them with chalk 3/8" or 5/8" as the scale on washer No. 1 indicates. This scale is laid off by a standard rule 1/8" apart. The washer is made to fit all standard spindles and can be used on emery wheels and polishing machines, the same as on polishing lathe. The washer is manufactured by Hunt and Streibich, Hamilton, O., who will be glad to send further particulars upon request.

POWDERED ALUMINUM

Among the many abnormal and exorbitant demands created by the war, perhaps no other demand was so out of the ordinary as that for powdered aluminum. Several uses, each of them not generally understood, claimed aluminum, and caused that metal to soar in price in a manner to make all other metals seem to recede, even in these days of universally soaring prices. Either as a scavenger of metals, or to give greater cohesions to the atomic components of steel, or to act as a munitions pyrotechnic, powdered aluminum came into sudden and feverish demand. This demand in normal times had been supplied by a very few concerns, who jealously locked away the priceless secret of the wonderful achievement of pulverizing aluminum, so that when they could not meet the newly created demand, the Provost Engineering Corporation of New York and Brooklyn undertook to do so.

After spending thousands of dollars in research work, in the prosecution of which several methods of actually powdering aluminum were evolved, most of which were discarded as being purely laboratory but not commercial successes, the Provost's engineers finally forced the secret from reluctant nature.

By far the greater amount of all aluminum used for munition purposes is used for pyrotechnic effects. To produce pyro-aluminum it is necessary to reduce this metal to what is known as 200 mesh, which, according to calculations made by the Provost Engineering Corporation, reduces each pound of aluminum to 768,000,000 particles; or, to what is practically an impalpable powder. This metal in the form of a powder of such fineness will readily explode when "clouded" or thrown in spray fashion, and because of its high actinice properties, aluminum is, next to magnetism, the best metal illuminant known, emitting a flash light of an almost blinding brilliance, besides generating a more intense heat than any other metal.

The use of pyro-aluminum for military purposes are but little

known. When dispatches from the front make mention of "star shells," they refer to shells loaded with a small percentage of powdered aluminum, which, if fired at night, will, upon exploding, emit a bright flash and announce to the gunners that fired them the exact spots when they exploded, and in that way serve as nocturnal range finders. If two hostile fleets should encounter one another at night, a great advantage would accrue to that side best equipped with aluminum loaded shells. The force so equipped should be able, all other things being equal, to so much the sooner "locate" or "pick up" the enemy, with results that should be in keeping with such an advantage. When searchlights have failed, aluminum loaded shells have "located" enemy air craft. Air pilots also carry bombs so loaded to give them hints of their location at night by dropping one to earth in enemy country.

Because of this unprecedented demand for it, alumium has advanced in price as perhaps no other metal has—somewhat over 400 per cent., so high in fact has the price of aluminum gone as mere junk that the Provost Engineering Corporation has reduced tons of fabricated aluminum that had never been put on the market for the purpose for which it had been manufactured, having a greater value as junk than it would have in the fabricated form. Everything has been reduced to powder from the merest junk to refined ingots and costly fabricated ware, and a new American industry has been evolved—that of producing ground, granulated, pulverized and pyro-aluminum on a really commercial scâle.

WELDING SHEET ALUMINUM

By C. R. Sutton*

So much attention has lately been given to the welding of aluminum that it may be of interest to tell briefly something of the application to the automobile industry.

For the benefit of those who are not familiar with the welding process, a detailed explanation of the method of proceeding with this class of sheet aluminum welding will prove interesting and instructive. In the majority of operations, the edges of the sheets to be welded are turned at right angles to a height from one-and-one-half to two times the thickness of the metal. After applying a flux to cause the metal to flow freely, in a manner described later, these up-turned edges are brought together and held with clamp tongs, such as are being used by the operator in Fig. 1. A short section of a few inches is then welded.

This welded section is allowed to cool thoroughly before removing the clamp, otherwise a crack would develop which might follow the subsequent welding, as aluminum when subjected to intense heat is very fragile. The tongs are then moved a few inches along the line of the weld and the metal welded to that point. This is continued until the entire section has been joined.

The part not yet welded is allowed to hang free, or is held by a helper, according to the size and shape of the sheets. Oftentimes the helper assists the welder by manipulating the free ends of the unwelded portion by bringing them into their true relative positions as the clamp is moved along the line of the weld in advance of the welding operator.

Preliminary "tacking" of the joint at regular intervals, with the welding flame, except at the point where the weld is begun, is not considered good practice as it has a tendency to cause a "buckling" of the sheets as the weld progresses, which interferes with the progress of the operator and nearly always results in bad workmanship.

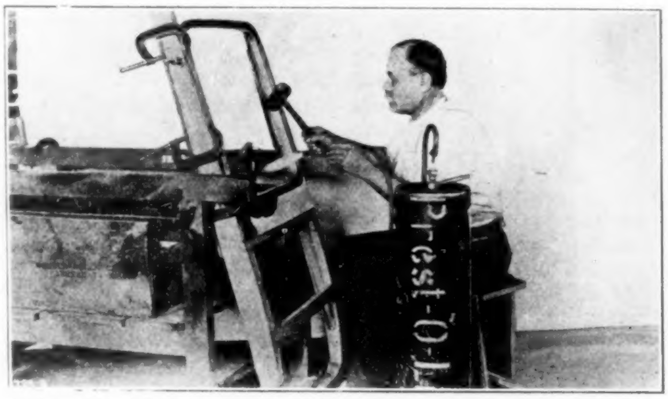
The proper use of a fluxing agent is one of the most important points to be watched in sheet aluminum welding. Its improper application nearly always results in imperfect work. The following information will prove useful to welders engaged on sheet aluminum work.

A special sheet aluminum flux, mixed with water to the consistency of cream, is applied to the line of the weld by means of a stiff brush similar to a painter's "sash tool." After the weld has been completed the flux is washed off either with a scrubbing brush or, as is more commonly the case, with a bunch of waste soaked in cold water, the water being applied freely.

It is necessary to remove all of the remaining flux from the line of the weld and the adjacent metal for the reason that practically all aluminum fluxes contain chlorides and aluminum is very susceptible to the action of chlorine, either in the free state or in combination with other elements. This causes corrosion which may or may not appear until after the body has been painted, when it will cause the paint to peel.

Not all fluxes can be used in a wet form, but in the event that a dry flux is used the same precautions in regard to removing all traces of the flux apply. It is customary to have a pail of water handy so that the scrubbing may be done immediately upon the completion of the weld.

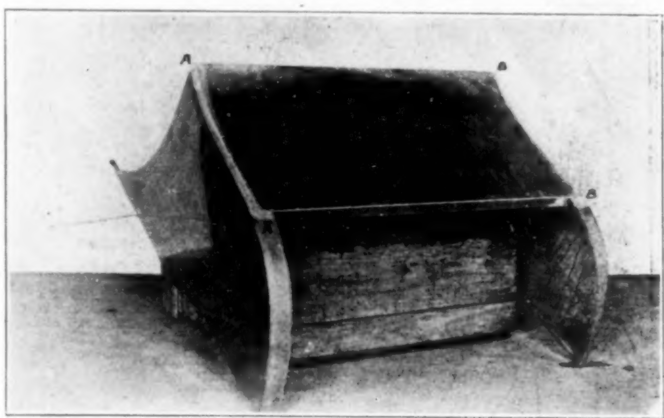
Care should be exercised not to "trap" the flux in the weld, in which case no amount of scrubbing would remove it. By "trapping in the weld" is meant the flowing together of the metal in the joint above and below the flux so that the flux cannot be entirely burned out.



OPERATOR WELDING IN FRONT PANELS OF FRANKLIN COWL. NOTE METHOD OF HOLDING SHEET IN POSITION FOR THE WELD. THIS ALSO ILLUSTRATES THE COMPLETE OXY-ACETYLENE WELDING OUTFIT.

An advantage in using flux in a moist condition is that, when applying the first coat with a piece of cloth, both edges of the metal must be rubbed to a distance of about three-eighths of an inch, which operation effectually removes any oxide from the surface of the metal and also destroys any greasy material which might form a film over the molten metal. After this is done a second coat should be applied sparingly with the stiff brush.

No filling material is used in the welding operation except at such points as a defect may occur, through either the improper



REAR BOOT ON FRANKLIN ROADSTER. TWO WELDS, INDICATED BY LETTERS "A" AND "B." TIME, 7 MINUTES.

handling of the welding flame or lack of a sufficient quantity of flux to allow the metal to flow together freely. In this case, usually a narrow strip cut from the same metal is used as a filler and the operator re-fluxes the line of weld before starting to fill in the defective spot.

After welding, the line of weld is hammered flat under spring power hammers, similar to those used for flat hammer work in all sheet metal industries.

The "Baby" welding blow-pipe used in this class of welding is a new product of The Prest-O-Lite Company, Inc., of Indianapolis, Ind. It is peculiarly adapted to sheet aluminum welding on account of its small size (weighing but a few ounces) and its easy manipulation. With it a workman can weld thin sheets more rapidly than with the heavier type of blow-pipe such as is commonly used in large repair work.

*Prest-O-Lite Company, Inc., Indianapolis, Ind.

ASSOCIATIONS AND SOCIETIES

REPORTS OF THE CURRENT PROCEEDINGS OF THE VARIOUS ORGANIZATIONS.

AMERICAN INSTITUTE OF METALS

President, Jesse L. Jones, Pittsburgh, Pa. Secretary and Treasurer, W. M. Corse. All correspondence should be addressed to the Secretary, W. M. Corse, 106 Morris avenue, Buffalo, N. Y. The objects of the Association are for the educational welfare of the metal industry. Annual convention with the American Foundrymen's Association in a succession of cities as invited. The 1916 convention will be held in Cleveland, Ohio.

To permit the foundrymen, who will attend the annual meetings of the American Institute of Metals, and the American Foundrymen's Association, which will be held in Cleveland, Ohio, during the week of September 11, 1916, to indulge in plant visitations to a greater extent than was possible at previous conventions, where two or three sessions were held daily, it has been decided by the program committee of this organization to have only one technical session per day, which will continue from 9:30 a. m. until the papers and discussions for that session have been disposed of, the hour of adjournment having been tentatively fixed at 1 p. m. This arrangement, it is believed, will meet with the hearty approval of all the members of these societies, and it will enable them also to devote more time to the inspection of the exhibits of foundry supplies and equipment and machine tools, which will be held concurrently at the Cleveland Coliseum. The conventions of these two societies will open one day earlier than formerly, the final session to be held on Friday. The annual meeting of the American Foundrymen's Association, therefore, will continue for a period of five days, from Monday, Sept. 11, to Friday, Sept. 15, inclusive. The meetings of both the American Foundrymen's Association and the American Institute of Metals will be held at the Hotel Statler, which also will be the headquarters of these two societies, but headquarters for the exhibitors will be at the Hollenden Hotel.

The meetings of the American Foundrymen's Association and the American Institute of Metals will be opened on Monday morning with a joint session of both societies, and the program will include the address of welcome and response; the annual addresses of the presidents of the American Foundrymen's Association and the American Institute of Metals and the reports of the secretaries of these two organizations. In addition, the representatives of the American Foundrymen's Association on the "Joint Conference Board on the Training of Apprentices" will present a report, and the report of the committee on "Safety and Sanitation" also will be heard.

A joint technical session also will be held on Tuesday, the program being limited to three papers, which will constitute symposiums on the following subjects: "Waste foundry sand, its reclamation and disposal," which will be discussed in various papers that will treat the topic from different viewpoints; "Results of the closer co-operation of the engineer with the foundry," as relating to the manufacture of aluminum and brass castings, cast iron, malleable cast iron and cast steel and "Proper gating of molds" for the manufacture of aluminum and brass castings, cast iron, malleable iron and steel castings.

The annual business meeting of the American Foundrymen's Association will be held on Wednesday morning, Sept. 13, when officers will be elected and reports of the executive committee and the auditors will be heard. Also a report will be made by the special committee of five on the conferences which it held during the year that led up to the conduct of the exhibit under the auspices of the American Foundrymen's Association and the American Institute of Metals.

Three simultaneous sessions will be held on Thursday morning for the discussion, respectively, of gray iron, cast steel and malleable iron, while on Friday morning malleable iron and steel sessions will conclude the business of the convention. The program, as outined, promises to be the best in the history of the American Foundrymen's Association, since the topics to be discussed are practical and relate to problems daily confronting the foundryman.

C. E. Hoyt, Lewis Institute, Chicago, exhibition manager, already has received a large number of applications for space, and the indications are that the Cleveland Coliseum, which affords a floor area of 60,000 square feet, will be crowded to capacity. No assignments of space have yet been made, nor has a floor plan been prepared, although this will be done within the next few weeks, when requirements of the various exhibitors approximately will be known.

A meeting of Cleveland foundrymen shortly will be held for the purpose of appointing committees for the entertainment of the visitors, to serve as guides in plant visitation and for the reception and entertainment of the ladies who will attend. It is probable that the annual banquet will be held at the Statler Hotel on Thursday evening, Sept. 14. Negotiations now are being conducted to secure several speakers of national reputation to deliver addresses at the banquet.

Secretary Corse announces that Bulletin No. 3 of the American Institute of Metals has been issued, giving the list of members arranged in both alphabetical and geographical order.

AMERICAN ELECTRO-PLATERS' SOCIETY

(AN EDUCATIONAL SOCIETY.)

President, W. S. Barrows, Toronto, Canada; Secretary-Treasurer, Walter Fraine, 507 Grand Ave., Dayton, Ohio. All Correspondence should be addressed to the Secretary. The objects of this society are to promote the dissemination of knowledge concerning the art of electro-deposition of metals in all its branches. The Society meets in convention in the spring of each year, subject to the decision of the executive committee. The next convention will be held at Toronto, Canada. The branch associations hold monthly and semi-monthly meetings in their various cities.

In relation to the convention for 1916 Walter Fraine, secretary-treasurer of the American Electro-Platers' Society, states:

"Believing that the best interests of the society would be served by holding the 1916 convention in the United States instead of Toronto, Canada, and the matter being presented to the Toronto branch, they have regretfully placed the selection of a convention meeting place before the executive board. The Cleveland branch have asked that the convention be transferred to that city, and the executive board have agreed to the transfer. H. J. Ter Doest, 59 Bowery street, Akron, Ohio, is chairman of the committee on arrangements for the Cleveland branch. The

members of this branch say that they will make the 1916 convention the finest in the history of the society."

Cleveland Branch—Charles Werft, secretary, 1341 East 112th street, Cleveland, Ohio.

Secretary Werft reports that at a special meeting held by the Cleveland Branch on April 22 at the American House to consider whether Cleveland should hold the National Convention of the American Electro-platers' Society, which was relinquished by the Toronto Branch on account of the war, the Cleveland members voted unanimously in favor of holding it in that city. The dates for the convention were set for July 6, 7 and 8, and will be held at the Hotel Statler.

Interesting papers are expected to be read and discussed; members are requested to attend and bring samples of their work and join in the discussions. Manufacturers and supply houses are also invited to display and demonstrate their newest and most up-to-date plating and polishing supplies and equipment, as free space will be provided in the sample room. All shipments should be addressed American Electro-platers' Society Convention, care Hotel Statler, Cleveland, Ohio.

Cleveland Branch extends a cordial invitation to all platers, superintendents, purchasing agents and managers of plating departments to attend the convention. Suitable arrangements are being made for the entertainment of all visitors.

St. Louis Branch—F. C. Rushton, secretary, 4405 Blair avenue, St. Louis, Mo.

Instead of the regular meeting this branch entertained its members on April 15, by giving a supper at the Laclede Hotel, after which the members adjourned to one of the parlors for a short meeting and then the rest of the evening was spent at one of the local theatres It was decided to hold all future meetings on the third Saturday of each month instead of the fourth as heretofore.

New York Branch—H. H. Reama, president, and William Fischer, secretary, 345 East 23d street, New York City.

The meetings of this branch will be held in Room 714, 32 Union Square, instead of 258 Pearl street, as heretofore. The branch will continue to meet the second and fourth Friday evening of each month.

Philadelphia Branch—Philip Uhl, secretary, 2432 North 29th street, Philadelphia, Pa.

The regular monthly meeting of this branch was held on Friday evening, May 5, at which time Dr. Lukens gave an interesting talk on the use of the different sulphurets as oxidizing agents.

The following officers were elected for the ensuing year: William J. Bell, president; Otto W. Mott, vice-president; Philip Uhl, secretary and treasurer; E. T. Homan, Samuel Barr and Charles V. Bayer, trustees; and Charles Stein, librarian. Philip Uhl was elected to act as representative of this branch at the Cleveland Convention; alternate, Samuel, Barr.

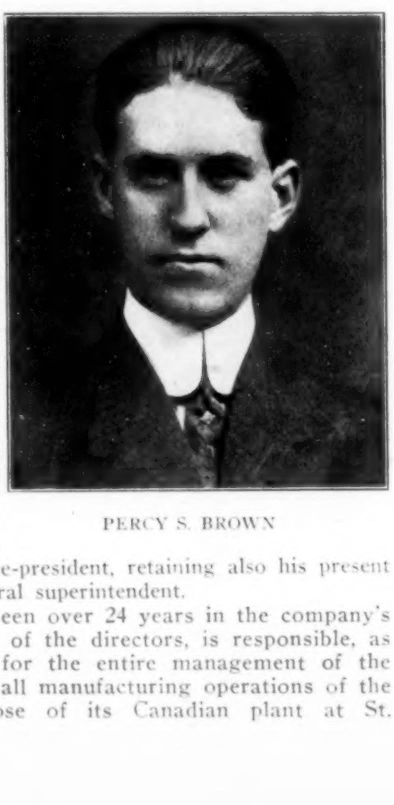
The Franklin Institute has issued invitations to the Stated Meeting, which will be held May 17, 1916, in the hall of the Institute, Philadelphia, Pa. At this meeting the presentation of the Franklin and Elliott Cresson medals will take place, and also there will be a demonstration of transcontinental and wireless telephony.

PERSONALS

ITEMS OF INDIVIDUAL INTEREST.

PERCY S. BROWN

Percy S. Brown, well known for his long connection with the plating industry as electro-chemist with the Western Electric Company, Chicago, Ill., and as one of the firm of Brown and De Witt, representatives for Waldberg & Company, Paris, France, for Persels plating salts, has now become connected with the Kathodian Bronze Works as general superintendent of their munitions factory at Nyack, N. Y. Mr. Brown has been a frequent contributor to THE METAL INDUSTRY for some years, his most notable article being a complete description of the process of nickel plating.



PERCY S. BROWN

At a meeting of the Board of Directors of the Yale & Towne Mfg. Co., held April 27, 1916, Joseph A. Horne was elected to the position of second vice-president, retaining also his present position and title of general superintendent.

Mr. Horne, who has been over 24 years in the company's service, and who is one of the directors, is responsible, as general superintendent, for the entire management of the Stamford works and of all manufacturing operations of the company, including those of its Canadian plant at St. Catharines, Ont. His election as a vice-president is in recognition of his successful administration in the past and of the ability which he has shown in discharging the duties of his very responsible position.

Dr. W. W. Clark, until recently efficiency engineer of the Seymour Manufacturing Company, Seymour, Conn., is now connected in the same capacity with the Nobel Steel Company, Baird, Shasta County, Cal.

William Stevens, foreman of the sheet mill annealing department of the Coe Brass Company, Ansonia, Conn., has resigned and accepted a position with the Western Cartridge Company, of Alton, Ill.

J. Howard Vail, galvanizing expert, is now in Portland, Ore., for a few months, installing a galvanizing plant for the Electro Galvanizing Works, of that city.

S. Herrick has been appointed general supervisor of the plating department of the Pathé Frères Phonograph Company, Belleville, N. J.

DEATHS

William J. Leddell, head of the Leddell Metals Company, Hunters Point, L. I., N. Y., died on April 21 at his home in Summit, N. J. He was seventy years old and was a native of Mendham, N. J. He is survived by his wife, son and daughter.

Alexander Schneider, one of the directors of the Roessler and Hasslacher Chemical Company, New York, died on Friday, April 21, 1916, in Frankfort, Germany.

TRADE NEWS

BUSINESS REPORTS OF THE METAL INDUSTRY CORRESPONDENTS.

WATERBURY, CONN.

May 8, 1916.

Prosperity is at high tide in the metal industries in this section, and practically every other industry is similarly affected. The tide continues to rise, and there is no way known for forecasting the time when it will begin to recede. There is consequently no decrease in the demand for labor, and there is also a widespread recognition of the rising market for labor. Bonuses and increased wages and salaries have become common. Peace reigns in all industries, although there have been some stormy times, and even those who were keen to strike are now busy trying to make up for lost time.

Building expansion has continued steadily in the larger factories here throughout the past two years, and wonderful progress has been made in record-breaking time. Now there seems to be a slight relaxation in building, but the energy thus saved in that direction is being turned into other channels, such as the development of equipment and the perfection of temporary conveniences, as well as the completion of plans for the proper conservation of water and other power to meet the needs of the hour and of the future.

There is a wonderful new undertaking for the improvement of the Scovill Manufacturing Company's property now under way, in the form of a great reservoir east of the city, a goodly portion of it being in the town of Wolcott. This requires the closing of two old roads, and before this is accomplished the company's contractors must first build two new roads connecting with state roads. Then the old roads will be at the bottom of the new reservoir, as well as a considerable acreage of surrounding territory. Two years ago no one would have suspected that such stupendous plans would have progressed so far, but the developments of the past eighteen months have been such that nothing is any longer considered impossible to the big manufacturing corporations.

Scovill's plant extends now from Mill street to Silver street, covering something like six times as much land as it covered two years ago. In addition the corporation owns many acres adjacent to its present property, and along the streams that supply water.

There has been a similar development of the American Brass Company's properties, here and in Ansonia, Torrington and Seymour, and practically every brass mill and machine shop in this part of the state has had to be enlarged.

One of the chief difficulties here for the past four months has been the lack of adequate freight facilities. Waterbury has been under embargo by the New Haven railroad, and by nearly every other railroad for so long that the first date has been forgotten. The strange thing about it all is that the blame is officially placed on the conditions at Harlem river, or at Maybrook, where the freight from the West and South is transferred to the New Haven system, but there are numerous instances of cars being delayed in transit that have been found at points on the New Haven system, well across the line, and have been left there neglected and unaccounted for for weeks.

All factory freight that is needed has been brought in by express, and whole trains of express cars, bearing spelter, copper, crucibles and similar commodities that were needed at once, have been brought here at great expense because there could be no dependence placed on the New Haven railroad's service.

These conditions led to a general meeting of the manufacturers, and General Manager Bardo, of the New Haven road, after there had been several sessions between the general manager and representatives of the chamber of commerce. The explanation of the general manager proved rather weak, and he was constantly on the defensive throughout the meeting. It was thought that some good would result, but little came from it. Adams Express Company representatives, who have been over the lines on inspection trips, have marveled at the crude methods of railroading followed, and to say that the New Haven management has received a couple of black eyes on account of its inability to meet the situation at all satisfactorily is to put it mildly. It is particularly aggravating to Waterbury because the first symptoms of possible congestion began here, and competent management would doubtless have prevented many of the difficulties that have arisen since. Interstate Commerce Commission officials have been here during the past week trying to straighten matters out, but there is no optimism over that fact.

Next to the freight congestion has come the population congestion problem, and several of the city's leading manufacturers recently accepted appointments to a commission to investigate housing conditions. There has been an exhaustive report on the subject presented to the city, and its numerous features are being studied. There is need for some 5,000 homes here, according to the report, largely due to the extraordinary increase in population since the present boom in brass goods wanted for war purposes began.

Aside from the munitions industries there is a very healthy condition in practically all other industries. The demand for clocks is large and apparently extending, and there is an improvement in the watch industry. The new factory of the Ingersoll concern, which was formerly the home of the New England Watch Company, and before that of the Waterbury Watch Company, has some 400 employees now, and its first watch, made on the new model, a $2.50 product, appeared about the middle of April. There are several other watch products made in this plant, which has been greatly improved, and which promises to be a thriving institution from now on. The watch business of the Ingersolls, which is handled in the Waterbury Clock Company's plant also, shows good condition and a considerable improvement over the situation a year ago.

Thomaston's watch industry, that of the Seth Thomas Clock Company, is still slow, but improving steadily.

Novelties are in great demand, and all the plants turning out these goods are busy. The lamp and burner business is good, and the plants making materials or sundries for automobile manufacturing find plenty to do, and are as active in the market for labor as the others.

The financial conditions are reflected in the report of the clearing-house here for the month of April. The increase in business over April, 1915, was about $3,000,000, and the total for the first four months of 1916 was $30,978,200, as compared with the total for the same months in 1915, which was $18,724,700, showing over $12,000,000 increase.

Rents are high, prices are high, living is high, and consequently wages are high, but conditions generally were never more prosperous.—F. B. F.

NEW BRITAIN, CONN.

May 8, 1916.

Business conditions with the metal manufacturers in New Britain continue most favorable, and never before has prosperity deigned to smile more brightly on either the employer or the employee. But underneath the exterior there seems to be a feeling of unrest among some of the laborers, and during the last week of April a strike was declared in the malleable iron department of the Malleable Iron Works, one of the city's oldest manufacturing concerns. The strikers demand a 25 per cent. increase in wages; also an increase so that piece workers may earn as high as $18 per week. It is said that at present such employees are unable to earn more than $1.75 per day. The strike is not a crippling one, however, and despite the depletion in the ranks the plant continues to do business. The grey iron molders have not presented any demands.

Sub-contracts for war munitions concerns are still being handled by various local concerns to their financial advantage, and it is known that the P. & F. Corbin division of the American

Hardware Corporation is doing a large amount of work for the American Can Company, a munitions concern. But general trade conditions are good, and at the Union Manufacturing Company a night shift is being employed. At the New Britain Machine Company it is no longer necessary to employ a day and night shift, but the concern is very busy, and at present is manufacturing a new machine; one that will turn out an all metal golf stick, the product of an inventor named Lard.

The Stanley Works is likewise booming, as are its various subsidiary plants at Niles, Ohio, and Hamilton, Ontario, Canada. The importance of the Canadian plant is such that David B. Marwick, for the past decade general superintendent of the cold rolled steel rolling mill, and recognized as an authority, has been relieved of his duties here, and transferred to Hamilton, where he will assume full charge. Valentine B. Chamberlain, who has worked under Mr. Marwick for a number of years, succeeds him at the New Britain plant.

As all the other manufacturing concerns are booming, so is the Fafnir Bearing Company, manufacturing ball bearings on a large scale. Although this concern is one of the city's latest manufacturing firms, it is necessary already to enlarge its plant to keep up with the rapidly growing trade, and at present a new $10,000 factory addition is being constructed.

Business conditions are also steadily improving at the Stanley Rule & Level Company, a concern that was injured a great deal at the outbreak of the war on account of the loss of foreign trade. Landers, Frary & Clark is doing well, and so is the Waterbury Tool Company, but it is only a matter of a few months at best when this last named concern will leave New Britain and move to Waterbury, where considerable property rights are owned, enabling expansion at reduced expense. Several of the more up-to-date concerns here are making steady inroads into the trade of South America, and when the European war ends, Germany, which previously controlled this trade, will find serious opposition.—H. R. J.

HARTFORD, CONN.

May 8, 1916.

An idea of the greatly increased volume of business in the Hartford metal industries is given in the annual report of Colt's Patent Fire Arms Company, which was completed last week. Among other things, it is shown that the gross earnings for the past year were $2,827,328 and that the value of unfilled orders now on hand is $22,554,245, with others pending, and orders cannot be canceled. The net earnings of the company amounted to $2,470,944, nearly 100 per cent. on the capital stock of $2,500,000, and the net surplus to $1,897,026, after the deduction of dividends, which amounted to 24 per cent. for the year. The present rate of dividend is 10 per cent. regular and 40 per cent. extra, making a total of 50 per cent. a year. The net surplus a year ago was only $26,000. The report shows real estate, buildings and machinery to the value of $882,229 and cash investments of $8,917,262, of which $6,766,316 was advance payment on contracts not yet fulfilled, leaving the cash and investment item at $2,150,946, after writing off large depreciations.

The unfilled orders of $22,554,245 compare with unfilled orders of $2,030,000 a year ago. The company expects shipments in 1916 of $20,000,000 against $5,000,000 during the past year. It is shipping at the present time to nine foreign governments. Orders on hand are sufficient to run until April 1, 1917. Domestic orders since January 1 have shown a large increase and promise big things for the future. During the year, $700,000 of new machinery was ordered, on which $200,000 advance payment was made and on which $400,000 has since been paid, leaving $100,000 unpaid. Ninety per cent. of the machinery has been delivered. The average number of men employed in the year was 1,285 and 1,977 are employed at the plant at the present time, while constant additions are being made to the force. The company is now completing a building for office and shipping purposes and this will release space for manufacturing 500 feet long and 50 feet wide. Directors of the company have been re-elected as follows: William C. Skinner, Charles L. F. Robinson, Frank A. Schirmer, Charles M. Jarvis, Louis R. Cheney, Morgan G. Bulkeley, D. Newton Barney. The directors have re-elected officers as follows: President, C. L. F. Robinson; first vice-president, William C. Skinner; vice-presidents, F. C. Nichols and S. M. Stone; treasurer, Walter H. Penfield; assistant treasurer, H. D. Fairweather; secretary, A. L. Ulrich.

It is said that the annual reports of other factories in the city are also very encouraging, but none other has been made public. Aside from difficulty with freight embargoes and other obstacles presented by the strike of the Seamen's Union, the local metal industries are faring much better today than they were a month ago, when they were facing many trying situations. At no time during the past several months, however, has business been anything less than "rushing" and the officials of the various plants are frank to assert that the coming year will be a banner one with them.

The new $400,000 brick and steel factory of the S. K. F. Ball Bearing Company, of Gottenberg, Sweden, is now completed and in a few days more than 300 workmen will be engaged there in the manufacture of a high grade of bearings. The office building, adjoining the factory, was occupied for the first time Monday, May 1, by a force of about seventy, a large percentage of which was from an office which the corporation has been conducting in New York for some time past. It was not until a special barge was chartered in New York that it was possible for the company to overcome the tie-up caused by the seamen's strike, and to succeed in getting necessary raw materials here. The new factory is situated on New Park avenue about 2,000 feet south of the factory of the Royal Typewriter Company, and was erected by the Stone & Webster Engineering Corporation of Boston since last December. Much expensive and specially designed machinery from Sweden has been installed. The S. K. F. Ball Bearing Company is one of the largest concerns of its kind in the world and employs over 3,000 men in its factory in Sweden. Previous to the outbreak of the European war the company had planned to build a large factory at Rouen, in the northern part of France, but was obliged to postpone the erection of this building.

Many of the officials of the Hartford branch have come here from New York, among them being S. B. Taylor, sales manager; H. H. Gildner, chief engineer; G. C. McKenzie, credit manager; A. V. Farr, advertising manager; R. C. Mabley, head of the automobile sales department, and R. E. Patterson, head of the hanger sales department. H. P. Baldwin, formerly assistant superintendent of the New Departure Manufacturing Company in Bristol, is to be the superintendent of the plant, and it is expected that the output will be about 1,000 bearings a day. Uno Forsberg, formerly of New York, is to be the mechanical engineer.

Fifty men employed as assemblers at the East Armory of the Colt's Patent Fire Arms Manufacturing Company went out on a strike last week because a demand for 45 cents an hour was not granted by the management. The strike is not the result of any activity on the part of labor organizations.—T. C. W.

PROVIDENCE, R. I.

May 8, 1916.

As has been the case for many months, the metal trades factories are the real leaders of the industrial world in this state, and the foundries, machine shops, machinery builders and machine tool makers are rushed with orders and are looking about for additional help that will keep the plants running to capacity. Many of the departments are running overtime, and more would be operated on this schedule if sufficient help could be secured.

Domestic orders seem to have been gaining the upper hand during the last few months, and the demand is growing heavier all of the time, it is said by those who keep in close touch with affairs and those who are in a position to observe. For a long time it was evident that orders from the belligerent powers in Europe were having a substantial effect upon the local conditions among the metals industries here, but the utmost secrecy was maintained regarding everything connected therewith. Recently, however, although no open assent has been given, much of the mystery has been thrown off and the factories are being operated openly.

The manufacturing jewelry industry, of all the metal working

trades, continues to be considerably of a contrary character. Many concerns report good and increasing business, while others, and many of them among the oldest established in this great center of jewelry manufacture, claim that business is far below normal, with apparently little prospects for any great improvement in the immediate future. There is considerable demand for help, and the indications are that as a whole the industry was in far better condition than at any time during the year 1915.

The Brown & Sharpe Manufacturing Company has been very actively identified recently in patriotic movements and matters pertaining to preparedness, as well as for the general welfare and improvement of its employes. It has inaugurated a campaign to have the foreign-born employes become naturalized citizens of the United States. Many of the 7,000 men employed at this plant were born in other lands and, although they have lived in this country for many years and have learned to speak the English language, they have neglected to become citizens. The officials of the corporation say that this is true to a large extent among the employes born in England or Canada. Many of the employes are already taking advantage of the opportunities offered by the corporation in the Americanization classes which are being held at the plant during the noon hours. For some time the foreign-born men have been receiving instruction in the English language, and classes are now being held to instruct the men in matters essential to naturalization.

Recently the company notified its employes that it stands ready to pay half of the expense of sending fifty of its employes to the military training camp at Plattsburg this summer, in addition to giving them full pay at the rate of 55 hours a week during the period of training.

The General Electric Company has begun work on the erection of a new plant in this city, to be located on a plot of land containing 232,715 square feet, on Atwells and Harris avenues. The proposed building will be of modern factory steel and brick construction, having a floor space of approximately 125,000 square feet, and will be utilized for making electric lamp bases, giving employment to between 500 and 600 skilled labor. A modern power plant will be used to supplement the work that is now being done at the Providence Base Works, on Hospital street, this city.

The Willemin Manufacturing Company has been incorporated under the laws of Rhode Island, with a capital of $100,000, to make rifles, tools, ammunition, etc., the incorporators being Thomas F. Cooney, Daniel H. Morrissey and John J. A. Cooney. The articles of incorporation provide that the concern shall have its principal office in this city. Members of the corporated state that details have not yet been definitely settled, although John Cooney, who is a member of the lower branch of the Rhode Island General Assembly, and attorney for the new concern, states that Edward Willemin, who for several years conducted a manufacturing jewelry plant at 95 Pine street, is the moving spirit in the matter.—W. H. M.

ROCHESTER, N. Y.

May 8, 1916.

The metal trade for Rochester may be reported as being very good. In fact ever since the first of the year trade in the Flower City has been fairly brisk. A few of the local concerns, such as Ritter Dental Manufacturing Company, have been unusually busy. A large part of the output, of course, has been for export. The foundries are enjoying a fine spring trade, while the electroplaters are busier than they have been for some months. Electroplating supply houses report that during the last month they did an extraordinary amount of business among the local platers.

The Erdle Perforating Company will erect a reinforced concrete addition to its plant in York street. The addition will be used for factory purposes, and it is estimated to cost $9,000. It will be a 50 x 214 foot one-story building.

The Rochester Stamping Company will erect a one-story 68 x 100 foot brick addition to their factory on Anderson avenue, at an estimated cost of $8,000.—G. W. G.

BUFFALO, N. Y.

May 8, 1916.

Last month was one of the busiest months this year for the Buffalo metal dealers. Business, as a whole, assumed a more confident tone. This, however, may be due to the general feeling which prevails among the local business men that the forthcoming months will be exceedingly prosperous ones. Nearly every known industry in this city is busy. All of this is looked upon as a fair indication as to what one may expect in the near future.

One disturbing factor, however, in this market has been the question of what effect will Wilson's late note to Germany have on the metal trade? "This jingoism," said one of the local metal men, "upon which some Americans exist, and the great war in Europe are hardships to the metal trade. Throughout it has caused an almost continuous advance in metal prices. And should we break with Germany, and eventually go to war with her, it will mean a still greater advance in metal prices, and a curtailing of the foundries' supply of metals. It will also mean a greater scarcity of labor than already exists, and business generally will be in a terribly unsettled condition."

Every foundry, with the exception of one or two, in this city is being worked to capacity. Last month was an unusually good one. One foundryman states: "The prices of metals are advancing more rapidly than we can advance our prices on foundry work. In fact one hesitates to advance prices so rapidly on old customers. Had it not been for these things," he continued to say to THE METAL INDUSTRY correspondent, "we would have made a nice big pot of gold. And this not only applies to last month, but every month since the first of the year, when business began to take a more healthy tone."

The American Bronze Company was recently granted permission by the Supreme Court to mortgage its property to Clark H. Timmerman, of this city. "We are placing this mortgage," said Charles Knorr, one of the principal stockholders of the company, "in order that we may be able to enlarge and better equip our foundry. For example, this week," he continued, "we installed five additional molding machines and other items of equipment. With our enlarged quarters, better facilities and new equipment, we expect to be in a better position to handle our trade." The newly elected officers of the company are: Charles Griffiths, president and treasurer, and E. Z. Mason as secretary. F. Rentz, formerly with Paul S. Reeves of Philadelphia, Pa., is their new foundry superintendent.

William Marr, of the National Bronze Foundry, said: "We have been so busy during April that I was compelled to turn down some of the orders which were offered to me."

The R. L. Tuck Company, of Thompson street, North Tonawanda, N. Y., has placed in operation its new foundry. The company is now equipped to make brass, bronze, and aluminum castings. This is the first and only foundry of its kind in the Tonawandas.

The Unique Brass Foundry is now comfortably settled in its new foundry on Grant street. This is the newest and one of the most up-to-date foundries in Buffalo.

Schnell Bronze Bearing Company, Inc., reports business as being very brisk and it is doing considerable brass and bronze work for one of the local plumbing concerns.

S. A. Day Manufacturing Company is very busy at present. They report that potash is exceedingly scare and very hard to get.

The American Radiator Company recently equipped its plant with one of the best and most up-to-date electroplating establishments in the city of Buffalo.

During April, a number of the local electroplaters were compelled to hire additional help. Prices are beginning to stiffen, but the outlook for the future is very encouraging.

The Fries Plating Company is replating all of the fixtures for the Hotel Statler, of Buffalo. They are also doing considerable work for a number of the local specialty manufacturers.

The Washington Plating Works have secured additional help for both their clerical and manual labor forces. They are contemplating the enlarging of their plant.

The finished metal manufacturers, rolling mills, etc., are moving as briskly as they were during the month of March. This has been an exceptionally good year for this branch of the metal trade.

The Buffalo Copper and Brass Rolling Mill has made some additional improvements in its plant during the last month.

It has been announced in relation to the River road in the Town of Tonawanda that the Aluminum Company of America has secured an option of 40 acres of land on the River road near Three Mile Creek. Part of the land is located on the water front. The impression prevails that the Aluminum Company is planning to erect a big steel plant on the property it purchased.—G. W. G.

NIAGARA FALLS, N. Y.

May 8, 1916.

April was a brisk month with most of the non-ferrous metal dealers in this city, and judging from the present indications it is expected that the summer months will be exceedingly good. The only thing to mar this brisk trade was the strikes at a number of the big plants. To meet the expected summer trade a number of the local plants are making improvements and additions to their present establishments. Labor is scarce in spite of the fact that top-notch wages are bing paid.

The foundries enjoyed a fine trade during April, the price of metal being the only thing concerning which the local foundrymen complained. The Titanium Alloy Manufacturing Company and the Frontier Brass Foundry have both booked a sufficient number of orders during the last month to keep them busy for some time to come.

Trade with electroplaters is decidedly much stronger than it was during the month of March. Housecleaning time, and the refinishing of a number of the local summer hotels have furnished an abundance of work in this line. The jewelry, silverware and souvenir manufacturers are also getting a good volume of trade. This, however, is about the normal spring boom. Most of the customers of these manufacturers are merely stocking up for their summer trade.

The Spirella Company reports a very busy April, and that it was much better than April a year ago. C. E. Leffel, the general superintendent of this company, with offices at the Cataract City, recently organized a company of which he is president, known as the Niagara Insul-Bake Specialty Company. They will manufacture Ford timer caps out of a substance known as Bakelite.

During the month of April the Carborundum Company had the largest payroll in its entire history, there now being employed about 1,800 men in its local plant. The contract for its Canadian plant, to be located at Niagara Falls, Ont., and to be known as the Canadian Axolite Company, has been awarded. The buildings will be of brick, heavy construction covered with iron, and will cost $100,000. The office building will be 50 by 80 feet; mixing room, 65 by 160 feet; furnace room, 60 by 200 feet; crusher, 85 by 65 feet, and the three transformer rooms, 30 by 30 feet. There will be three side tracks leading into the plant.—G. W. G.

COLUMBUS, OHIO

May 8, 1916.

The metal market in Columbus and central Ohio has ruled fairly active during the past month. As a general proposition prices have been strong, with the exception of spelter and lead. Both of these metals have shown a slight weakness. The volume of business is good and in many directions is increasing. Prospects for the future are good in every way. Copper remains firm and there is a good demand in every locality. No. 1 scrap copper is selling around 26½ to 27 cents per pound. Brass is also in good demand, and red scrap is selling at 21½ to 22 cents per pound, and yellow scrap at 17½ to 18 cents. Tin is rather quiet, being quoted at 50 cents. Zinc is selling at 19½ cents, and type metal is one of the strongest points in the market.

Quite a few new metal-using concerns have been started in Ohio recently. Munition factories are going well and their consumption is good.

The Ohio Metal Company has completed a large addition to its plant at Fourth street and Fourth avenue. The addition houses a furnace for the making of ingot brass. The plant is one of the most complete in central Ohio.

The Spencer Metal Products Company, of Spencer, Ohio, has been incorporated, with a capital of $25,000, to make metal products. The incorporators are R. F. Vandemark, George G. Bouthinon, K. L. Sage, H. Y. Hooper and D. M. Sage.

The Crain Lead and Zinc Company, of Cincinnati, Ohio, has been incorporated, with a capital of $50,000, to deal in metals. The incorporators are George M. Harding, Joseph T. Harrison, R. P. Meyers, John Q. Martin and Charles L. Swain.

The Mutual Smelting and Refining Company, of Columbus, Ohio, has been incorporated, with a capital of $10,000, to do smelting and refining. The incorporators are Charles N. Bagley, J. D. Jordon, H. W. Jenkins and S. C. Arfinkel.

The West End Stamping and Manufacturing Company, of Cleveland, Ohio, has been incorporated, with a capital of $50,000, to do a stamping business. The incorporators are O. D. Eshelman, Louise Menger, Bessie Shatto, Marie Kurka and L. C. Shaver.—J. W. L.

CINCINNATI, OHIO

May 8, 1916.

The almost vertical rise in the price of metals continues, as might be expected, to occupy the serious attention of members of the trade in this vicinity, inasmuch as it is playing a very important part in contract work. However, in most cases founders and supply men are protected by provisions covering the rise, and their chief worry is the increasing difficulty in securing metals, even at the current prices, this, of course, being the fundamental cause of the increase. Demand for equipment calling for the use of copper, bronze, brass and so forth was never more active, the operations of machine-tool manufacturers continuing at an extraordinary rate, calling for the employment of three shifts a day. On the other hand, the coppersmiths, whose chief market lies with the distillers and brewers, have within the past few months been receiving the benefit of a sudden demand for equipment designed to enable distillery plants to turn out high-proof alcohol. To the uninitiated the impression has been that the distillery plant can turn out alcohol with little or no change in equipment, but this is so far from being the case that it is said that to change an ordinary distillery over to the manufacturing of alcohol for the market requires an investment of $40,000 and upward. This goes very largely into copper, and the high price of that metal, together with the activity among the shops, has made the price of the work what it now is, amounting to several times what similar work would have cost before the war. The large profits which are being realized by makers of alcohol have tempted very many distillers into the business, however, and while coppersmiths are now unable to promise completion of any such work short of six months hence, orders continue to come in.

Threats of further labor trouble among the machinists employed in the various machine-tool and similar plants in and around Cincinnati have been heard, the union men claiming that they can tie up many plants, and seriously inconvenience all, unless the increased wages which they demand are granted. The manufacturers, however, are holding out undisturbed, pointing to the present active operations as proof of the inability of the strikers to hinder work. They are confident that there will be no great difficulty in keeping men as long as wages remain at their present high levels, and regard demands for further increases as unreasonable.

The Edna Brass Manufacturing Company, one of the active foundries in the brass trade in Cincinnati, is preparing to construct a storage building at the rear of the plant, on Reading Road, to afford much-needed space for finishing material, as well as supplies. The building is to be two stories high, and 60 by 67 feet, of brick and steel construction.—K. C. C.

DETROIT, MICH.

May 8, 1916.

Operations in all the trades involved in the use of metals continues on an extremely active basis in Detroit, and in the manufacturing centers along the Canadian border. Detroit, the "Wonder City," is attracting the attention and admiration of the whole world. Its building is proportionately better and greater than that of any other manufacturing city with products of quality and quantity unsurpassed, and is the third exporting city in America. Everyone is acquainted with the fact that it is first in the manufacture of automobiles, producing more than

65 per cent. of the world's output, and manufacturing all grades from the Packard to the Ford, the annual output being more than 400,000 cars at a valuation exceeding $400,000,000.

One Detroit brass plant manufactures more than half of the lubricators made in this country, and it is one of the largest producers of lubricants. People wonder at the smoothness and rapidity of its growth, but Detroit has the largest axle factory in the world and the largest pin factory, producing more than 12,000,000 pins daily. From the above can be seen the prominent part that the metals enter into in these different lines of manufacture.

The different brass manufacturing plants along the Canadian border are running to their full capacity.

The Allyne Brass Manufacturing Company, located at Crawford avenue, is very busy on plumbing brass goods. The Master Carburetor Company, Fort street, is running a day and night force to keep up with the orders on hand as they are unable to supply the demand on their product. The General Aluminum & Brass Manufacturing Company is putting the finishing touches to the new additions to its plant and installing new machines. The company is also running day and night.—P. W. B.

TRENTON, N. J.

May 8, 1916.

With the advent of summer comes considerable building in this city, and this adds to the prosperity of the metal industry. One real estate broker alone has broken ground for fifty houses, while many of the Trenton factories are building or will build good size additions. More hardware is now used in the ordinary dwelling house than formerly. The demand for metal articles is on the increase in every section, and the demand for copper and brass is far greater than it has been in many years. It is safe to say that there is not a scrap of copper or brass lying loose anywhere, except where it is packed up to be shipped away or to local foundries.

Junk dealers have inserted advertisements in the newspapers asking for various kinds of metals. This is the only way all the scrap material can be gathered up and the market supplied. Junk dealers are paying 18 cents a pound for copper wire, 15 cents a pound for light copper, 14 cents a pound for red brass, 10 cents a pound for yellow brass, 8 cents a pound for light brass, 4 cents a pound for lead, 10 cents a pound for zinc, 30 cents a pound for aluminum, 20 cents a pound for pewter, 25 cents a pound for tinfoil, and 30 cents a pound for block tin pipe. Trolley, telephone and telegraph companies have recently lost heavily through the stealing of copper wires from the lines in this section. Thieves found that it paid well to take a horse and wagon at night and strip sections of wires from the poles because of the price received from junk dealers. The latter take all kinds of chances in buying stolen metals from thieves. Unoccupied dwelling houses in this city have also been stripped of brass, copper and lead trimmings by thieves. The order recently placed with United States smelting concerns for many millions of pounds of copper for foreign nations will cause a big demand on smelting plants and junk dealers for copper.

The Billingham Brass & Machine Company has a standing order to buy all the brass from every Trenton junk dealer. The company has several government orders on hand, calling for considerable brass, and pays a good price for the same, but saves paying freight on it from some other city. The plant is running full-handed.

William G. Wherry, head of the Skillman Hardware Manufacturing Company, is home from a business trip through the Middle West. In talking with a representative for The Metal Industry, he said: "I was surprised to find business so good in the West. I also found labor scarce, which is a good sign that there is prosperity. With the greater majority of men working and money easy to get, the country has no kick coming." The Skillman company ships considerable of its product through the West, and Mr. Wherry was looking after some orders while there.

The Mercer Automobile Company is very busy and a force is working nights. Since the big addition was built, measuring 85 by 400 feet, the company is now able to manufacture various metal parts for autos. Some of the brass parts are made at the plant of the Trenton Brass & Machine Company. The J. L. Mott Company is busy working on its second big war order, and the plant is being operated in three shifts. The majority of the night shift is busy in shaping shells. The Bechtel Engraving Company is holding its own, and President Daniel J. Bechtel expects a good summer. The Trenton Smelting and Refining Company is rushed with orders at its two Trenton plants, while the National Electric Plating Company finds business better. Sparks from a cupola caused a slight fire at the plant of the Trenton Smelting and Refining Company. The Mackenzie Foundry Company also suffered a loss from the same cause.—C. A. L.

LOUISVILLE, KY.

May 8, 1916.

Louisville coppersmiths report that they are now working night and day in an attempt to keep up with new work which is rolling in considerably faster than it can be handled. There is a marked shortage in experienced copperworkers as for several seasons very few new men have been employed or broken into the business, with the result that good men are not to be had at any price. Skilled mechanics are in big demand in all lines of manufacturing, in some cases being almost impossible to obtain.

On account of the big advance in the price of metals, especially copper, brass, etc., there has been a great deal of stealing going on during the past few weeks. Local coppersmiths are now forced to employ night watchmen, and barricade their doors to keep from having expensive material stolen.

Prices quoted on copper and brass goods are only subject to immediate acceptance, and long-time delivery. Sheet copper can be had in about thirty days' time, and the manufacturers of sheet copper, in some cases, are keeping the dealers fairly well posted on prices. Tube mills, on the other hand, are taking four and five months to make deliveries on some sizes, and are not keeping the trade posted. Quotations in Louisville the latter part of April were sheet coppers, 37 to 38 cents per pound; tubes, basic price, 40 to 41 cents; and ingot, July delivery, 28 to 29 cents.

A large copper concern of Louisville reports that it is filled up on ordinary copper work for at least five months, and is unable to accept any immediate business. This condition is general in the trade.

Charles A. Finegan, formerly proprietor of a small brass foundry at Twenty-seventh and Slevin streets, Louisville, is now conducting a big smelter at Depew, N. Y., and has devised an improved method of extracting brass from cinders, old crucibles, etc., and is buying up many old foundry drums, which are being sent East for rectifying. It is estimated that by the new methods of extraction several thousand dollars' worth of brass will be recovered.

The Freville-Platt Company, Louisville, manufacturers of steam pumps, has again changed its name to the J. J. Reilly Manufacturing Company, under which title the concern operated for many years. The capital stock has been raised from $30,000 to $50,000.

The National Foundry and Machine Company, 1408 West Main street, Louisville, manufacturers of pumps, brass goods, etc., has arranged to build a one-story brick addition to the plant at a cost of about $1,500.

Harding & Felix, sheet metal workers, of Henderson, Ky., are now working in tin, copper, galvanized and other metals.

G. D. C.

NEWARK, N. J.

May 8, 1916.

No trouble to get orders, but very difficult to get materials with which to fill them; some trouble in shipping goods because of the congested transportation facilities, and prices of materials ranging from half again as much to two or three times as much as a year ago at this time, would about sum up the condition of the metal business in Newark and vicinity at the present time. There is no doubt that each passing month business is becoming fundamentally stronger. But it is not natural and normal yet. A year ago thousands were out of work and the unemployment problem was acute, though beginning to recover somewhat from the still worse conditions that prevailed during the winter. Now, and for several months back, many manu-

facturers of metal goods have been unable to get sufficient competent help, some of them advertising almost constantly for help in local and outside papers. This condition is in part due to the better business conditions prevailing now, but in large measure to the fact that manufacturers of war supplies are paying such high wages and in need of so many hands that it drains the legitimate field of industry.

In a like manner the manufacture of munitions prevents a free development of normal business and accounts for the abnormal condition in the metal trade. Manufacturers of the regular lines of metal goods have to pay twice as much for materials as a year ago, because munition makers must have the metal and are willing to pay almost any price to get it. The risk for deliveries has been almost entirely shifted to the shoulders of the metal goods manufacturers by the makers of the materials. Where a year ago many of the material men would deliver goods at the door of the manufacturers, today orders are received with the understanding that all risks of every nature are to be taken by the consignees. No definite time of shipment is given as a rule, but often there is a statement to the effect that shipments cannot be expected within from two or three to four or five months.

If it were not for the high prices now prevailing for metal goods, there would be a still larger demand for many lines. Where it is possible to defer ordering at the present time, many are postponing their orders in the hope that prices will soon break. This cannot be done, however, in the majority of cases because of the fact that the general improvement in business has caused such a demand, even at increased prices, that postponement of orders is out of the question.

The Newark Brass Works, 18-20 Lawrence street, report that business is very good at the present time as far as ability to get orders is concerned. The high prices of materials, however, has somewhat of a tendency to check some business, and the difficulty of getting materials makes it hard to fill orders.

Local platinum importers and dealers report that no more of this metal is coming in from Russia, which is the world's principal source of supply. Some is coming in from South America, but the quantity is so small that it has little effect on the market. High prices are paid for scrap metal, and every possible source is combed for metal not actually in use.

Some of the local manufacturers of brass goods have been receiving more for their scrap metal during the past few months than the metal itself cost a year or year and a half ago. It is exceedingly hard for manufacturers of brass goods to get material with which to fill their orders. Some makers of brass novelties and small articles have turned to the use of aluminum, where this has been possible, and this has created an unusual demand for that metal.

The industrial exposition to be held in connection with the celebration of the 250th anniversary of the founding of Newark will be opened by President Wilson on Saturday, May 13. Eighty-nine industries have been booked for this exposition. Among these will be several lines of the metal industry. The jewelry exhibit will be one of the features of the exposition. There will also be exhibits of metal advertising novelties, art metals, tin ware of different kinds, and wire cloth and wire work.—R. B. M.

NEWS OF THE METAL INDUSTRY GATHERED FROM SCATTERED SOURCES

It is reported that the Rome Wire Company, Rome, N. Y., are building a casting shop which will contain ten fires.

The addition to the power house of the Bridgeport Brass Company, Bridgeport, Conn., will be 42 x 101 feet, one story high.

It is reported that, owing to increased business, the Continuous Casting Company, Garwood, N. J., is doubling its building and capacity.

The Excelsior Needle Company has awarded the contract for the construction of an addition to its plant on Field street, Torrington, Conn.

F. G. Miller & Son, electro-platers, 73 John street, Belleville, N. J., announce that they are now ready to produce a genuine gun metal finish on steel novelties, etc.

An addition to the office of the American Pin Company, manufacturer of brass, bronze, aluminum and German silver castings and novelties, Waterville, Conn., is now under construction.

The Great Western Smelting and Refining Company, Chicago, Ill., has established a branch office in New York, 2244-46-48 Woolworth building, under the management of H. L. Green.

The Sterling Blower Company, Hartford, Conn., announce that there is no foundation for the published report that they are to build two one-story additions, 32 x 180 feet, and 42 x 130 feet.

The Twisted Wire & Steel Company, New York, have removed its factory and offices from 515 Greenwich street, to its new quarters at 437-453 Eleventh avenue, New York.

The Newell Manufacturing Company, manufacturer of brass goods, etc., Ogdensburg, N. Y., has let the contract for an addition to its building, 70 x 40 feet, which will be used principally as a store house.

The Ornamental Casting Company has started a foundry at 122 Wooster street, New York, and will specialize in the manufacture of white metal castings of all kinds. The company will also make the molds for producing the castings.

The Killark Electric Manufacturing Company, Twenty-second, Washington and Lucas avenues, St. Louis, Mo., is in the market for screw-cutting and plating machinery. They operate japanning, lacquering, soldering, stamping and galvanizing departments.

Work has begun on the new five-story shop, office and warehouse building for the Aluminum Goods Manufacturing Company, Manitowoc, Wis., to cost about $100,000 and which, it is expected, will be ready for occupancy about the first of September.

The G. W. J. Murphy Company, Merrimac, Mass., has leased from the Amesbury Realty Trust Company, at Amesbury, Mass., a three-story brick building, which will be used for the manufacture of the Murphy automobile curtain fastener and other metal specialties.

Ground has been broken for the erection of a two-story brick building, 50 x 118 feet, for the North-West Aluminum & Brass Foundry, Inc., of Rochester, N. Y. The building will cost about $20,000. This company began business in a small way in 1912, and at the completion of the new building will employ about 100 men.

The Ajax Metal Company, manufacturer of metals, Philadelphia, Pa., is having plans prepared for a four-story fireproof addition to its plant. The first floor of the new addition will be used for storing metal; second floor, wash room and metal pattern storage; third floor, wooden pattern storage, and fourth floor for flasks.

E. S. Cullen, for a number of years connected with the Niles-Bement-Pond Company, New York, as representative, has retired from that company and opened up a business which will be known as the E. S. Cullen Machinery Company, manufacturer of machine tools and locomotive equipment, Leader-News building, Cleveland, Ohio.

The Gehnrich Indirect Oven Company, manufacturer of japanning, lacquering and enameling ovens, Brooklyn, N. Y., has received another contract from the National Cash Register Company, Dayton, Ohio, for six more indirect gas-heated radiator type ovens, which makes a total of seventeen Gehnrich ovens in operation at this plant.

The Department of Commerce, Washington, D. C., by William

C. Redfield, secretary, has issued a notice to the public that, owing to the shortage of paper material, attention should be giving to the saving of rags and old papers. A list of dealers in paper stocks can be obtained from the local chamber of commerce or board of trade.

The Eynons-Evans Manufacturing Company, brass manufacturer, Fifteenth and Clearfield streets, Philadelphia, Pa., has awarded a contract for the construction of a manufacturing building, estimated to cost about $10,000. This company operates the following departments: Foundry, brass machine shop, and tool and grinding room.

The Taunton-New Bedford Copper Company, Taunton, Mass., is adding to its mill an extension 150 x 60 feet, and is also erecting a shed 30 x 300 feet. These extensions are being made for the purpose of giving increased room and an opportunity to rearrange their machinery, and not for the purpose of increasing output, as had been reported.

Alfred T. Wagner, who was connected with Frederic B. Stevens, manufacturer of foundry and platers' supplies, Detroit, Mich, for many years, is now established in business on his own account at 675 Atwater street, East Detroit, Mich. Mr. Wagner states that he is in a position to fill orders for all kinds of fire brick, foundry and platers' supplies and equipment.

W. J. Murphy, operating an aluminum and bronze foundry, Amesbury, Conn., reports that ever since starting in business on his own account last July he has been very busy and expects soon to enlarge his plant. Mr. Murphy was previously connected with the Merrimac Plating Works, Merrimac, Mass., as manager, and in addition to the foundry operates a polishing and plating department.

The Safety Insulated Wire and Cable Company, Bayonne, N. J., reports that on account of the wire mills being abnormally busy it has been unable to get copper wire for its products, and therefore has been forced to shut down its plant for a short period. The company also states that it has enough orders on hand to keep it running for the next six months if it could get the necessary raw material.

Owing to the congestion in freight on the railroads serving the Naugatuck Valley district, the American Brass Company is still having to resort to extreme methods in obtaining its supply of metal. Two large cargoes of copper were recently brought by lighters to a wharf at Fair Haven, Conn., via the Quinnipiac River. From there the metal proceeded on its journey via automobile trucks to the company's mill in Waterbury, Conn.

The Magnolia Metal Company, 113 and 115 Bank street, New York, is offering for sale a limited quantity of antimony which it is smelting at a new plant it has just completed at Matawan, N. J. The smelter was primarily built to supply the company's own needs. Its product has been thoroughly tested, runs 99 per cent. pure or higher, and in every way conforms to accepted standards. The company is the only one on the Atlantic coast producing antimony.

White and Brother, Inc., smelters and refiners, Philadelphia, Pa., report that due to the large volume of business which they have on hand, it has been imposcible for them to suspend opertions long enough to rebuild their plant, after the recent fire, so they are now working in the open. The force of workmen employed by White and Brother may be seen working outdoors, with oilskin suits and hats, busily turning out the W-B brand of casting copper, which is so well known that the firm is sold up for the next month or two.

Pearson, Peppard and Company has opened offices in the Woolworth Building, 233 Broadway, New York, to conduct a general business in brass and copper rolling-mill products, etc. Messrs. Pearson and Peppard have been closely associated with the metal business for several years, both in mill products and virgin metals, such as tin, copper, lead, spelter, antimony, aluminum, etc. Mr. Pearson was with Bruce and Cook, New York, for several years, and lately with the North American Copper Company, also of New York.

An interesting side light on the value of individual stocks has been thrown on the appraisal of the estate of Charles M. Moore, manager of the Paris branch of Tiffany and Company. The stock of this company, which had a par value of $1,000, has been set at $7,683 per share in the report filed by the Transfer Tax Appraiser. The highest known price paid for the stock of Tiffany and Company was $6,000 a share when ten shares were bought by the company itself in 1913. While in 1914 one share was sold for $5,700, there were 2,400 shares originally issued.

The Stamford Rolling Mills Company, Springdale, Conn., and the American Cupro Nickel Company, Stamford, Conn., have combined, but for the present the plants will be operated indepently. The Stamford Rolling Mills has acquired the stock of the American Cupro Nickel Company, and the officers of the former company assume full charge of both plants. The officers of the combined corporations are: Evans R. Dick, president; Harry Wright, vice-president, and Earl T. Shaw, secretary and treasury. The directors are the above mentioned and E. C. Potter, Mr. Plier and George Wright.

The company reports that the following additions are being made at the two plants: At Springdale, 2 additions to the rolling mill of 102x180 feet, and a two-story office building 50 by 75 feet. Four sets of rolls and two annealing furnaces are being installed. At Stamford an addition to the rolling mill consists of a building 100 by 112 feet, and there will be put in eight sets of rolls and two annealing furnaces. The present melting capacity of the two plants is approximately 250,000 pounds per day.

The Doehler Die-Casting Company, of Brooklyn, N. Y., and Toledo, Ohio, begs to announce to the trade that it has acquired a controlling interest in the American Die Casting Company, of Newark, N. J., which will hereafter be known as the Doehler Die-Casting Company of New Jersey. Its present management remains unchanged. This plant, housed in an up-to-date factory building, conveniently located, equipped with modern die-casting machinery and appliances, and under most efficient management, is well adapted to the Doehler policy of quality production and dependable service now obtained in their Brooklyn and Toledo plants.

Robert Kann, general analytical chemist and metallurgist, 124 Front street, New York, advises that in order to take care of all his requirements in analytical work he has completely reorganized his chemical laboratory and has leased the entire sixth floor of the building in which he is now located. He has also engaged several experienced chemists and added all modern appliances in order to handle his work with even more promptness and accuracy than heretofore. He states that reports may be had within a day and rush orders are given special attention Anyone having analytical work to be done is invited to inspect his laboratory.

After two weeks or more of strenuous work on the part of the operators and strikers at the plant of the National Conduit and Cable Company, Hastings-on-Hudson, N. Y., everything has finally quieted down. More than 3,000 employes joined in the strike, which at times assumed such serious proportions that it was necessary to call out the National Guard from various parts of the state. The strike was finally settled by the strikers accepting a raise of two cents an hour offered by the company. It also was agreed that no discrimination would be shown in reemploying men in the plants and that all strikers who wished to return would have jobs.

The Durham Duplex Razor Company, Jersey City, N. J., has leased the building at Mercer and Colgate streets, in which it has installed a quantity of machinery salvaged from the building which was destroyed by fire on March 19. The company is only occupying one-third of its former floor space and employing less than one-third of its former equipment, but by operating three shifts it is producing its normal average of 9,000 razors per day. It is expected that its new plant, now under construction on Baldwin avenue, will be ready for occupancy by the fifteenth of May. The company is in the market for wood-polishing wheels and other polishing materials.

The Basic Mineral Company, Box 276 N. S., Pittsburgh, Pa., state that it recently shipped a whole carload of its brass and bronze flux, Radioclarite, to the Yale & Towne Manufacturing Company, Stamford, Conn. On account of the impossibility of getting this car past the freight embargo at New York, this shipment was sent to Oyster Bay, Long Island, and from there taken across Long Island Sound to the Yale & Towne plant at Stamford by boat. This shipment probably breaks the record for brass fluxes as regards the quantity of material involved in a single order, and the company states that it is ready to fill other orders as large or larger.

THE WILLIAM PENN HOTEL AT PITTSBURGH, PA., FITTED WITH BRASS AND COPPER TUBING BY THE BALTIMORE TUBE COMPANY, BALTIMORE, MD.

The Quigley Furnace Specialties Company, Inc., 26 Cortlandt street, New York, has been formed by W. S. Quigley, formerly connected with the Metal Production Equipment Company, Springfield, Mass. The officers of the new company are W. S. Quigley, president; H. A. Kimber, vice-president, and J. H. McPadden, secretary. The new company has been organized to manufacture and deal in a line of high-grade furnace materials, equipment and appliances for the improvement of furnace construction, and will be taken care of through a department known as the Furnace Specialties Department. Another department which they will operate will be an Engineering and Contracting Department, through which it is prepared to analyze and make comparative statements of operating costs of powdered coal, gas and fuel oil. Of the officers of the above firm, W. S. Quigley the president is the well-known furnace expert who has been connected with the trade for many years, notably with the W. S. Rockwell Company and the Rockwell Furnace Company prior to his connection with the Metal Production Equipment Company. H. A. Kimber, the vice-president was formerly assistant engineer of the Loomis-Pettibone Company of New York, which was absorbed by the Power and Mining Machinery Company of Wisconsin. He was afterwards chief engineer of their fuel department and installed numerous powdered coal burning plants and some of the largest fuel gas plants in the country. He was afterwards with the Quigley Furnace and Foundry Company, Springfield, Mass.

NEW ENGLAND BRASS COMPANY

The New England Brass Company, Taunton, Mass., has filed papers of incorporation in Boston, Mass., and the following officers have been chosen: William M. Lovering, president, and Fred H. Gooch, treasurer. The directors, in addition to the above, are Franklin D. Williams, Nathan Newbury, and J. L. Potter, of Fall River, Mass., and also H. C. Carpenter, of New York.

The new company has been formed for the purpose of building a brass rolling mill and they will manufacture sheet brass of all descriptions. The rolling mill will be 125 by 60 feet and contain three sets of rolls, have attendant annealing furnaces and other rolling mill appliances. The casting shop will be 60 by 50 feet and contain twenty fires. It is expected that the plant will be completed and in operation by June first, and that a hundred hands will be employed at the outset.

H. C. Carpenter, who is mentioned above as one of the directors, is general superintendent. Mr. Carpenter is well known in the brass business, having been connected for twenty years in various capacities, and finally as general superintendent of the Seymour Manufacturing Company, Seymour, Conn. For the past year Mr. Carpenter has been connected as superintendent with the Waclark Wire Company, Elizabeth, N. J.

INCREASE IN CAPITAL STOCK

The Alemite Metals Company, manufacturer of die castings, etc., Chicago, Ill., has increased its capital stock from $25,000 to $50,000.

The Torrington Manufacturing Company, manufacturer of special machinery for brass and copper mills and also metal goods, has increased its capital stock from $200,000 to $250,000.

FINANCIAL REPORT

The annual report of the International Nickel Company, New York, N. Y., just published, shows the total assets on December 31, 1915, as $57,758,671, and liabilities as $52,114,608, leaving a surplus of $5,644,063. The net quick assets, or excess of current assets over current liabilities, amounted to $11,745,766 on December 31, 1915, as compared with $8,347,827 on March 31, 1915, $7,384,563 on March 31, 1914, and $7,195,608 on March 31, 1913. The quarterly common dividends paid above were 5 per cent. each. In addition, the company paid a 10 per cent. stock dividend on the common on November 1, as an extra dividend, but this is not deducted above. The earnings on the common stock for the above nine months' period were equal to approximately 20 per cent. on the increased amount of common stock now outstanding.

BUSINESS TROUBLES

The referee in bankruptcy has made a final declaration of 3½ per cent. dividend in the matter of the bankrupt firm of the Renziehausen Company, Newark, N. J., under date of April 24.

A receiver for the Colton Manufacturing Company, Montpelier, Vt., has been applied for by the creditors of the company. The indebtedness of the company is $46,500, and interest secured by mortgage, and $50,000 unsecured. This firm was started in Montpelier under the name of Fisher & Stratton for the manufacture of saddlery hardware in 1861, and was afterwards reorganized as Fisher & Colton, which continued until the final reorganization several years ago under the present title. The main reason given for the receivership is that the saddlery hardware business has become demoralized on account of the automobile.

REMOVAL

The General Platers Supply Company, Inc., have removed their office to the Columbia Building, 29 Broadway, New York.

The New York offices of the American Brass Company, 99 John street, were moved May 1 to the new Western Union building on the corner of Dey street and Broadway.

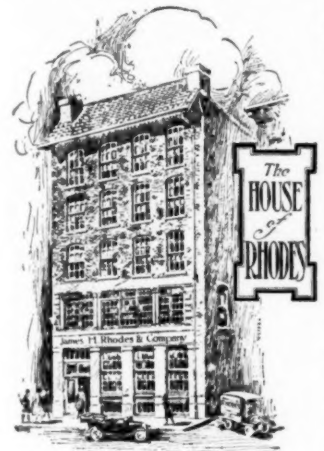
The Miami Foundry Company, Hamilton, Ohio, has decided to move its plant to Miamisburg, Ohio. Extra equipment will be installed and the present capacity of the plant greatly increased.

Dr. Carl Hering, consulting engineer and inventor of the Hering Electric Furnace, has moved his office to 210 South Thirteenth street, Philadelphia, Pa., where he will have better laboratory facilities.

The United States Smelting Company, manufacturer of the D. R. W. copper, U. S. S. Co. spelter and U. S. S. Co. electrolytic lead, formerly located at 42 Broadway, New York, has moved to 120 Broadway.

The Homogenous Lead Coating Company, manufacturers of lead coated pipes, valves, chemical vessels and tanks, etc., with headquarters at 1-2 Old Pye street, Westminster, S. W., England, on account of increased business, has taken larger premises adjoining the General Steam Navigation Company's works at Stowage, Deptford, England.

Owing to the rapid expansion of business James H. Rhodes & Co., importers and manufacturers of industrial chemicals, and also manufacturers of the well-known Carlsruhe cleaner, has found it necessary to move its Chicago, Ill., office from 162 West Kinzie street to 157-159 West Austin avenue, where it will occupy a five-story building.



In New York the company has an office and warehouse at 162 William street.

It is stated that during the past six months nearly 500 metal workers in the United States and Canada have adopted Carlsruhe cleanser in their work Besides metal cleansers, the company also furnishes pumice, sponges and chemicals of various kinds for the metal trades.

INCORPORATIONS

Business organizations incorporated recently. In addressing them it is advisable to include also the names of the incorporators and their residence. Particulars of additional incorporations may frequently be found in the "Trade News" columns.

To manufacture metals.—The Springfield Brass Company, Springfield, Vt. Capital, $80,000. Incorporators: Paul E. Lutner, Hugh McPhee and Fred B. Gill.

To produce molybdenite.—The International Metal Company, Superior, Wis. Capital, $100,000. Incorporators: H. J. O'Briene, J. E. Greenfield, and H. E. Greenfield.

To manufacture bronze and aluminum castings.—Metal and Alloy Specialties Company, Buffalo, N. Y. Capital, $10,000. Incorporators: E. A. Moore, M. C. Teall and E. Rae.

To operate a brass foundry.—The Federal Brass Foundry Company, Boston, Mass. Capital, $10,000. Incorporators: F. M. Callahan, president, and Ralph C. Barnstead, treasurer.

To weld all kinds of metal castings.—Atlas Welding and Supply Company, Pittsburgh, Pa. Capital, $10,000. Incorporators: Frederick J. Kettling, Joseph Gehring, Frank C. Rugh and Charles B. Gehring.

To manufacture ornamental work of brass, copper, etc.—Usona Manufacturing Company, St. Louis, Mo. Capital, $15,000. Incorporators: Isaac Graham, F. C. G. Lanz and Hermann Branckmann.

To manufacture metal alloys, compositions, etc.—John Wood Manufacturing Company, Conshohocken, Pa. Capital, $50,000. The company will operate a brass foundry, brass machine shop, tool room, galvanizing, tinning, brazing and japanning departments.

To manufacture brass and bronze castings.—The Hugh Merrie Company, Cincinnati, Ohio. Capital $25,000. Incorporators: Carl T. Foley, H. E. Zerfey, Eleanor S. Patterson, F. M. Schwein and Rose L. Brink. This company has been incorporated to succeed Hugh Merrie, who has been in this business for many years. The company will operate a brass and bronze foundry, brass machine shop, tool and grinding room and plating and polishing departments.

INQUIRIES AND OPPORTUNITIES

Under the directory of "Trade Wants" (published each month in the rear advertising pages), will be found a number of inquiries and opportunities which, if followed up, are a means of securing business. Our "Trade Want Directory" fills wants of all kinds, assists in the buying and selling of metals, machinery, foundry and platers' supplies, procures positions and secures capable assistants. See Want Ad. pages.

PRINTED MATTER

Plating Barrel.—The Abbott Ball Company, Hartford, Conn., have issued a folder descriptive of the features of the U. S. Junior plating barrel for which they are agents.

Automatic Furnaces.—The W. S. Rockwell Company, New York, N. Y., have issued catalog No. 30, which contains discussions of furnace and furnace operations from the standpoint of automatic handling.

Iron Lined Tubes.—Tubes of brass, bronze and aluminum lined with iron are described and illustrated in a little booklet just issued by the Phenix Tube Company, manufacturers, with general offices and mills in Brooklyn, N. Y.

High Pressure Covering.—The Armstrong Cork and Insulation Company, Pittsburgh, Pa., have issued a pamphlet giving full description of the advantages of the Nonpareil high pressure covering for high pressure and superheated steam lines, boilers and so forth.

Plating Supplies.—C. Upham Ely, New York, N. Y., has issued a four-page pamphlet giving description of the various plating and polishing supplies which he now handles. Among these are to be seen the Crown rheostats, rotoplaters or plating barrels and the celebrated line of Ely nickel anodes.

Grinding Machinery.—The St. Louis Machine Tool Company, St. Louis, Mo., have just issued a new catalog, No. 15, on grinding, polishing and tapping machinery. The work contains a complete description and illustrations of the extensive line of machinery for finishing metals manufactured by this company.

Fluxes.—The Radio Magazine for April, 1916, has just been published. This magazine is devoted to the C. M. Miller fluxes and amalgamators known as Keystone and Radioclarite, the latter being a special material used for the fluxing of brass, bronze and copper and so forth. The magazine contains a great deal of interesting matter relating to fluxes and to other interests of C. M. Miller of the Basic Mineral Company, Pittsburgh, Pa.

FOREIGN TRADE OPPORTUNITIES

For addresses of these enquiries apply to Bureau of Foreign and Domestic Commerce, Washington, D. C., and give file numbers.

Sulphate of copper, zinc wire, iron bars, etc., No. 19,700.—An importing agency in Portugal informs an American consular officer that it desires to purchase sulphate of copper and zinc wire. Catalogs and price lists, together with full information, are desired.

Brass Tubes, No. 19098.—An inquiry has been received by the Bureau from Argentina for quotations on 400 brass tubes, 0.035 millimeter internal and 0.039 millimeter external dimensions. 2.60 meters long. Quotations should be made f. o. b. New York or other water points.

CATALOG EXHIBIT

An exhibition of every kind of catalog may be seen at The Metal Industry office, 99 John street, New York. The Metal Industry is prepared to do all of the work necessary for the making of catalogs, pamphlets, circulars and other printed matter. Estimates will be furnished for writing descriptions, making engravings, printing, binding, for the entire job from beginning to end or any part of it.

METAL MARKET REVIEW

New York, May 8, 1916.

COPPER.

The month of April was the biggest copper buying month that the trade had ever known. The purchases by the British and French governments amounted to around 400,000,000 pounds. Domestic consumers came into the market and bought very heavily for deliveries over the entire year and into the first quarter of 1917. The buying movement is about over now, and the market is very dull.

The large orders for munitions are hardly likely to come along like they did last year. England and France are just about able to take care of their needs. There may be some special work that will come over here, but the big rush is over. Already there are indications that the building of new plants for war material has been overdone. As an instance brass rods and sheets, discs, cartridge cases and shells can be turned out now seemingly in unlimited quantities, but it is a question whether the orders will come along. With this new competition the big profits obtainable last year will be cut down, and should the war end this fall, and the copper market break wide open, as it is most likely to, there is probably going to be more or less trouble.

There is quite a lot of speculative copper on the market, and also some resale copper from consumers, who always overbuy on a market like we had in April. Prices during the month advanced nearly 4 cents per pound for prompt deliveries, and about 2 cents per pound for the later deliveries. Prompt and May Electrolytic is offered at 30 to 30½ cents, and last quarter is offered at 28 to 28½ cents, and for first quarter in 1917 there are sellers at 27½ to 28 cents.

Lake is offered at from 28½ to 30 cents, according to delivery, and casting for May, June and July shipment at 27½ to 27¾ cents. The exports for the month are very small, only about 20,000 tons. It is estimated that stocks of copper have increased about 10 million pounds during the month. The production is estimated at 185 million pounds, and it may be more than that.

TIN.

The tin market has been quite active, and from 50½ cents at the opening prices reached 54½, and touched 49½ as the lowest point in the month, and closed at around 50 cents. The consumption was quite heavy, and is estimated at 4,202 tons.

LEAD.

The Trust price has been held at 7½ cents per pound New York basis for the entire month. The independents have been able to realize from 8 to 8½ cents per pound on all they could sell, and at the close the price is down to 7½ cents New York.

SPELTER.

The spelter market has been quite weak, and from 19¼, the opening price at East St. Louis, prices dropped to 17½ at the close. Futures have been offered down to 16 and the market at the close is dull and more or less weak.

ALUMINUM.

The aluminum market has been very dull, and prices show very little change. The strike at the Aluminum Company's plant seems to have upset deliveries, and consumers and dealers have never known when their contract metal was coming along. There has been very little export business doing. The Aluminum Company of America has made sales for 1917 at 35 cents for No. 1 ingots and sheets at 40 cents.

ANTIMONY.

Prices have declined about 6 cents per pound during the month. From 44 cents at the opening for Chinese and Japanese to 38 cents at the close.

QUICKSILVER.

The quicksilver market has been manipulated to try and shake out a holder of a considerable quantity of quicksilver. Prices have been regularly reduced each week from $190 a flask at the opening, to $115 a flask on May 2. Consumers have held off, and it is predicted, with any kind of demand, prices will take a quick upward turn. Price now $112.

PLATINUM.

The platinum market has been very dull, and prices are about $3 per ounce lower. The quotation today is $85 against $88 a month ago.

SHEET METALS.

Sheet copper has been advanced in accordance with the advance in ingot, and prices today are about 2 cents per pound higher at 36½ cents base. Copper wire is quoted at 32½ to 33 cents, and high sheet brass at 38 cents. Brass rods are down to around 35-36 cents.

OLD METALS.

The old metal market has been active, and prices higher on the advance in ingot copper. Brass and copper scraps have been in good demand, and the month shows a good turnover for the dealers in old metals.—J. J. A.

DAILY METAL PRICES

By an arrangement with the daily metal papers, The Metal Industry can furnish daily metal prices, and we offer a special combination subscription price of $10 per year for this service. The price of the daily paper alone is $10 and of The Metal Industry alone $1.00—combination offer $10.

APRIL MOVEMENTS IN METALS

	Highest.	Lowest.	Closing.
Copper.			
Lake	30.00	27.25	30.00
Electrolytic	31.00	27.25	30.50
Casting	28.00	26.00	27.75
Tin	54.60	49.50	50.00
Lead	8.00	7.50	7.50
Spelter	19.50	17.60	17.75
Antimony (Chinese and Jap.)	44.00	37.50	38.00
Silver	73½	60⅞	73½

WATERBURY AVERAGE

The average prices of Lake Copper and Brass Mill Spelter per pound as determined monthly at Waterbury, Conn.:

Lake Copper. 1915—Average for year, 18.94. 1916—January, 24.75. February, 27.75. March, 28. April, 29.

Brass Mill Spelter. 1915—Average for year, 17.50. 1916—January, 22.25. February, 22.75. March, 23.15. April, 23.20.

Metal Prices, May 8, 1916

NEW METALS.

NEW METALS.	Price per lb. Cents.
COPPER—DUTY FREE. PLATE, BAR, INGOT AND OLD COPPER. Manufactured 5 per centum.	
Lake, carload lots, nominal	30.00
Electrolytic, carload lots	30.50
Casting, carload lots	27.75
TIN—Duty Free.	
Straits of Malacca, carload lots	51.50
LEAD—Duty Pig (Bars and Old 25%; pipe and sheets 20%. Pig lead; carload lots	7.50
SPELTER—Duty 15%.	
Brass Special	20.00
Prime Western, carload lots, nominal	17.75
ALUMINUM—Duty Crude, 2c. per lb. Plates, sheets, bars and rods, 3½. per lb.	
Small lots, f. o. b. factory	72.00
100-lb. lots, f. o. b. factory	66.00
Ton lots, f. o. b. factory	63.00
ANTIMONY—Duty 10%.	
Cookson's cask lots, nominal	.....
Hallett's cask lots, nominal	.....
American	38.00
Chinese, Japanese	38.00
NICKEL—Duty Ingot, 10½. Sheet, strip and wire 20% ad valorem.	
Shot, Placquettes, Ingots, Blocks	45.00
ELECTROLYTIC—5 cents per pound extra.	
MANGANESE METAL	nominal
MAGNESIUM METAL—Duty 25% ad valorem (100 lb. lots)	5.00
BISMUTH—Duty free	4.75
CADMIUM—Duty free ......nominal	1.80
CHROMIUM METAL—Duty free	.75
COBALT—97% pure	2.00
QUICKSILVER—Duty, 10% per flask of 75 pounds	150.00
GOLD—Duty free	$20.67
PLATINUM—Duty free ......$85.00 to	88.00
SILVER—Government assay—Duty free	.72⅞

INGOT METALS.

INGOT METALS.		Price per lb. Cents.
Silicon Copper, 10%	according to quantity	40 to 42
Silicon Copper, 20%	" "	40 to 42
Silicon Copper, 30% guaranteed	" "	40 to 42
Phosphor Copper, guaranteed 15%	" "	39 to 43
Phosphor Copper, guaranteed 10%	" "	37 to 41
Manganese Copper, 30%, 2% Iron	" "	50 to 55
Phosphor Tin, guaranteed 5%	" "	65 to 70
Phosphor Tin, no guarantee	" "	44 to 47
Brass Ingot, Yellow	" "	17 to 20
Brass Ingot, Red	" "	23 to 25
Bronze Ingot	" "	22 to 25
Parsons' Manganese Bronze Ingots	" "	32 to 33½
Manganese Bronze	" "	30 to 33
Phosphor Bronze	" "	24 to 26
Casting Aluminum Alloys	" "	45 to 50

PHOSPHORUS—Duty free.
According to quantity .... 35 to 40

OLD METALS.

Dealers' Buying Prices. Cents per lb.	OLD METALS.	Dealers' Selling Prices. Cents per lb.
22.00 to 23.00	Heavy Cut Copper	25.00 to 26.00
21.00 to 22.00	Copper Wire	24.00 to 25.00
18.00 to 19.00	Light Copper	21.00 to 22.00
17.00 to 17.50	Heavy Mach. Comp	18.50 to 19.00
13.50 to 14.00	Heavy Brass	16.00 to 16.50
11.00 to 12.00	Light Brass	13.00 to 13.50
14.00 to 15.00	No. 1 Yellow Brass Turnings	15.50 to 16.00
14.00 to 15.00	No. 1 Comp. Turnings	16.00 to 17.00
6.50 to	Heavy Lead	.... to 7.00
12.00 to 13.00	Zinc Scrap	14.00 to 15.00
25.00 to 30.00	Scrap Aluminum Turnings	25.00 to 30.00
30.00 to 35.00	Scrap Aluminum, cast alloyed	25.00 to 30.00
35.00 to 40.00	Scrap Aluminum, sheet (new)	45.00 to 50.00
23.00 to 24.00	No. 1 Pewter	25.00 to 26.00
20.00 to 24.00	Old Nickel	20.00 to 24.00
20.00 to 24.00	Old Nickel anodes	20.00 to 25.00

PRICES OF SHEET COPPER.

BASE PRICE, 37.50 Cents per Lb. Net.

SIZE OF SHEETS. Width.	LENGTH.	64 oz. and over.	32 oz. to 64 oz.	24 oz. up to 32 oz.	16 oz. up to 24 oz.	15 oz.	14 oz.	13 oz.	12 oz.	11 oz.
		Extras in Cents per Pound for Sizes and Weights Other than Base.								
Not wider than 30 ins.	Not longer than 72 inches.	Base	Base	Base	Base	½	1	1½	2	2½
	Longer than 72 inches. Not longer than 96 inches.	"	"	"	"	½	1	2	3	4½
	Longer than 96 inches. Not longer than 120 inches.	"	"	½	1	2	3	5	7	
	Longer than 120 ins.	"	"	1	1½					
Wider than 30 ins., but not wider than 36 inches.	Not longer than 72 inches.	"	"	Base	Base	1	2	3	4	6
	Longer than 72 inches. Not longer than 96 inches.	"	"	"	"	1	2	4	6	8
	Longer than 96 inches. Not longer than 120 inches.	"	"	1	2	3	4			
	Longer than 120 inches.	"	1	2	3					
Wider than 36 ins., but not wider than 48 inches.	Not longer than 72 inches	"	Base	1	2	3	4	6	8	9
	Longer than 72 inches. Not longer than 96 inches.	"	"	1	3	4	5	7	9	
	Longer than 96 inches. Not longer than 120 inches.	"	"	2	4	6	9			
	Longer than 120 inches.	"	1	3	6					
Wider than 48 ins., but not wider than 60 inches.	Not longer than 72 inches.	"	Base	1	3	5	7	9	11	
	Longer than 72 inches. Not longer than 96 inches.	"	"	2	4	7	10			
	Longer than 96 inches. Not longer than 120 inches.	"	1	3	6					
	Longer than 120 inches.	1	2	4	8					
Wider than 60 ins., but not wider than 72 ins.	Not longer than 96 inches.	Base	1	3	8					
	Longer than 96 inches. Not longer than 120 inches.	"	2	5	10					
	Longer than 120 inches.	1	3	8						
Wider than 72 ins., but not wider than 108 ins.	Not longer than 96 inches.	1	3	6						
	Longer than 96 inches. Not longer than 120 inches.	2	4	7						
	Not longer than 120 inches.	3	5	9						
Wider than 108 ins., but not wider than 120 ins.	Not longer than 120 inches.	4	6							

The longest dimension in any sheet shall be considered as its length.

CIRCLES, 8 IN. DIAMETER AND LARGER, SEGMENTS AND PATTERN SHEETS, advance per pound over prices of Sheet Copper required to cut them from .... 3c.

CIRCLES LESS THAN 8 IN. DIAMETER, advance per pound over prices of Sheet Copper required to cut them from .... 5c.

COLD OR HARD ROLLED COPPER, 14 oz. per square foot and heavier, advance per pound over foregoing prices .... 1c.

COLD OR HARD ROLLED COPPER, lighter than 14 oz. per square foot, advance per pound over foregoing prices .... 2c.

COLD ROLLED ANNEALED COPPER, the same price as Cold Rolled Copper.

ALL POLISHED COPPER, 20 in. wide and under, advance per square foot over the price of Cold Rolled Copper .... 1c.

ALL POLISHED COPPER, over 20 in. wide, advance per square foot over the price of Cold Rolled Copper .... 2c.

For Polishing both sides, double the above price.

The Polishing extra for Circles and Segments to be charged on the full size of the sheet from which they are cut.

COLD ROLLED COPPER, prepared suitable for polishing, same prices and extras as Polished Copper.

ALL PLANISHED COPPER, advance per square foot over the prices for Polished Copper .... 1c.

ZINC— Duty, sheet, 15%. **Cents per lb.**

Carload lots, standard sizes and gauges, at mill....25½ cent basis, less 8%
Casks, jobbers' prices 26½
Open casks, jobbers' prices 27

Metal Prices, May 8, 1916

PRICES ON BRASS MATERIAL—MILL SHIPMENTS.

In effect April 28, 1916.

To customers who buy over 5,000 lbs. per year.

	Net base per lb.		
	High Brass.	Low Brass.	Bronze.
Sheet	$0.39	$0.40	$0.41
Wire	.39	.40	.41
Rod	.39	.41	.42
Brazed tubing	.44	—	.46
Open seam tubing	.44	—	.46
Angles and channels	.44	—	.46

To customers who buy 5,000 lbs. or less per year.

	Net base per lb.		
	High Brass.	Low Brass.	Bronze.
Sheet	$0.41	$0.42	$0.43
Wire	.41	.42	.43
Rod	.41	.43	.44
Brazed tubing	.46	—	.48
Open seam tubing	.46	—	.48
Angles and channels	.46	—	.48

[Note.—Net extras for quality for both sections of above metal prices are not quoted due to the fluctuations in the price of zinc.—Ed.]

BARE COPPER WIRE—CARLOAD LOTS.

32c. per lb. base.

SOLDERING COPPERS.

300 lbs. and over in one order	38c.	per lb. base
100 lbs. to 300 lbs. in one order	38½c.	" " "
Less than 100 lbs. in one order	40c.	" " "

PRICES FOR SEAMLESS BRASS AND COPPER TUBING.

From 1¼ to 3½ O. D. Nos. 4 to 13 Stubs' Gauge, — per lb.
Seamless Copper Tubing, — per lb.

For other sizes see Manufacturers' List.

Due to fluctuations of the metal market we are unable to quote these prices.

PRICES FOR SEAMLESS BRASS TUBING Iron Pipe Sizes.

Iron pipe sizes with price per pound.

⅛ ¼ ⅜ ½ ¾ 1 1¼ 1½ 2 2½ 3 3½ 4 4½ 5 6

Due to fluctuations of the metal market we are unable to quote these prices.

PRICE LIST OF IRON LINED TUBING—NOT POLISHED.

	Per 100 feet	
	Brass.	Bronze.
⅜ inch		
½ inch		
⅝ inch		
¾ inch		
⅞ inch		
1 inch		
1⅛ inch		
1¼ inch		
1½ inch		
1¾ inch		
2 inch		

Due to fluctuations of the metal market we are unable to quote these prices.

PRICE FOR TOBIN BRONZE AND MUNTZ METAL.

Tobin Bronze Rod	41c.	net base
Muntz or Yellow Metal Sheathing (14" x 48")	40c.	" "
Muntz or Yellow Metal Rectangular sheets other than Sheathing	43c.	" "
Muntz or Yellow Metal Rod	41½c.	" "

Above are for 100 lbs. or more in one order.

PLATERS' METALS.

Platers' bar in the rough, 55c. net.

German silver platers' bars dependent on the percentage of nickel, quantity and general character of the order.

Platers' metal, so called, is very thin metal not made by the larger mills and for which prices are quoted on application to the manufacturer.

PRICES FOR SHEET BLOCK TIN AND BRITANNIA METAL.

Sheet Block Tin—18" wide or less. No. 26 B. & S. Gauge or thicker. 100 lbs. or more 5c. over Pig Tin. 50 to 100 lbs. 6c. over, 25 to 50 lbs. 8c. over, less than 25 lbs. 10c. over.

No. 1 Britannia—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more 7c. over Pig Tin. 50 to 100 lbs. 8c. over, 25 to 50 lbs. 15c. over, less than 25 lbs. 9c. over.

Above prices f. o. b. mill.

Prices on wider or thinner metal on request.

PRICE SHEET FOR SHEET ALUMINUM—B. & S. Gauge.

Base price, 60c.

Gauge.	Width. Inches.	1 ton.	50 to 2,000 lbs.	Less than 50 lbs.
20 and heavier	3-30			
	3-30			
21 to 24 inclusive	30-48			
	48-60			
25 to 26	3-30			
	30-48			
27	3-30			
	30-48			
28	3-30			
	30-48			
29	3-30			
	30-48			
30	3-30			

We are unable to quote these prices, but they can be had upon application to manufacturers and dealers.

The above prices refer to lengths between 2 and 8 feet. Prices furnished by the manufacturers for wider and narrower sheet. No charge for boxing. F. O. B. Mill.

PRICE LIST SEAMLESS ALUMINUM TUBING.

STUBS' GAUGE THE STANDARD. SIZES CARRIED IN STOCK.

Outside Diameters.

Stubs' Gauge.	Inches.	¼ in.	5-16 in.	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1¼ in.	1½ in.	1¾ in.	2 in.	2½ ins.	3 ins.	3½ ins.	4 ins.	4½ ins.
11.	.120.																	
12.	.109.																	
14.	.083.																	
16.	.065.																	
18.	.049.																	
20.	.035.																	
21.	.032.																	
22.	.028.																	
24.	.022.																	

We are unable to quote these prices, but they can be had on application to manufacturers and dealers.

Prices are for ten or more pounds at one time. For prices on sizes not carried in stock send for Manufacturers' List.

PRICE LIST FOR ALUMINUM ROD AND WIRE.

We are unable to quote these prices.

BASE PRICE GRADE "B" GERMAN SILVER SHEET METAL.

Quality.	Net per lb.	Quality.	Net per lb.
5%	44c.	16%	48c.
8%	45½c.	18%	48½c.
10%	46c.	20%	51c.
12%	47c.	25%	60c.
15%	47½c.	30%	66c.

GERMAN SILVER WIRE.

Quality	Net per lb.	Quality.	Net per lb.
5%	47c.	15%	53¾c.
8%	49c.	16%	54¼c.
10%	50½c.	18%	56¼c.
12%	52¼c.	30%	71¼c.

The above Base Prices are subject to additions for extras as per lists printed in Brass Manufacturers' Price List and from such extras 50% discount will be allowed. The above base prices and discounts are named only to wholesale buyers who purchase in good quantities. Prices on small lots are considerably higher.

PRICES OF SHEET SILVER.

Rolled sterling silver .925 fine is sold according to gauge quantity and market conditions. No fixed quotations can be given, as prices range from 1c. below to 4c. above the price of bullion.

Rolled silver anodes .999 fine are quoted at 2½c. to 3½c. above the price of bullion.